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THE MIDWAY STAGE

BY

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THE MIDWAY STAGE.

BY

Gilbert D. Harris.

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PRELIMINARY CONSIDERATIONS.

Divisions of the Eocene.

The Eocene series of our Southern States has been provisionally sub-divided as follows:—

EOCENE SERIES
6. Vicksburg stage.
5. Jackson stage.
4. Claiborne stage.
3. Lower Claiborne stage.
2. Lignitic stage.
1. Midway stage.

Aim and scope of this work.

The first or basal stage of this series is the Midway, and it is to this that we call attention in our present work. Part I is a brief sketch of the geological features of this terrane, as interpreted by former authors and by the present. These statements we believe will materially assist the beginner to understand certain passages found in different publications now quite at variance or diametrically opposed to each other. Part II is intended to include original descriptions, localities, whereabouts of types, figures, etc., of all well authenticated molluscan species known from the Midway.

Farther on we shall have occasion to call attention to the fact that between the basal Eocene deposits and the uppermost Cretaceous there is in this section of the country a decided break, both stratigraphic and faunal so that not one species is known certainly to have crossed from one formation to the other. At or immediately above this line an entirely new fauna makes its appearance upon the scene; whence it comes we cannot say, nor does it particularly concern us here, but its many subsequent modifications, and its decadence, and final merging into newer forms we hope to trace, if but imperfectly, during the following decade. With this evolutionary study we shall of necessity cull over, select out and re-publish all important paleontological facts heretofore published and hence do away with the greatest impediment to progress in our marine Tertiary faunas, namely, the scattered and almost inaccessible state of the literature.

Collection of fossils, field notes, etc., on which this work is based.

The Cornell University collection and the collectors' notes.—In the spring of 1895 the Trustees of Cornell University generously appropriated the sum of $400 to be expended in geological and paleontological research in the Tertiaries of our Gulf and Atlantic coast States. This sum was for defraying the field expenses of the writer and one assistant who were to volunteer their services during the following summer vacation in the field specified. Accordingly Mr. W. S. Hubbard and the writer left Ithaca in the latter part of June, and after visiting west Tennessee, northern and central Mississippi, central Alabama and western Georgia, returned North in the latter part of August. The collections made during this interval furnish what may be called the nucleus of the present work. They include not only fossils but sections and photographs of the more interesting or important localities. These may all be found catalogued and

stored in the archives of the department of Paleontology of Cornell University.

It is scarcely necessary to say that during the summer season in the South it is often extremely warm, and trying to one's health; and the writer, as well as the University at large, is deeply indebted to the skill, strength, good-will and never-tiring zeal of Mr. W. S. Hubbard.

Dr. Jas. M. Safford's collection of types.—In the Journal of the Academy of Natural Sciences, vol. iv, 1860, p. 390, *et seq.*, Gabb published descriptions and figures of some fossils which he referred to as borrowed of Dr. Safford, State Geologist of Tennessee, who in turn obtained them from the "Ripley Group" of Hardeman Co., Tenn.

Through the kindness of Dr. Safford, the present writer has had the opportunity of seeing the type collection as sent to Gabb thirty-six years ago. A few are missing, but the privilege of seeing the remainder has been a great boon. They are all re-figured herewith.

T. H. Aldrich's collection of fossils and drawings.—No one of late years has paid more attention to our marine Eocene paleontology than has Mr. Aldrich. His cheerful and prompt answers to inquiries, his transmission of fossils and all of the original drawings used in his article on the Midway fossils of Alabama published in a recent report by the Geological Survey of that State, have all tended to facilitate our present undertaking.

Collections of the U. S. National Museum.—All of the material collected ten years ago by L. C. Johnson in Hardeman Co., Tenn., and the interesting material from Oak Hill and Prairie Creek, Ala., have been transmitted by W. H. Dall of the Smithsonian Institution and the U. S. Geological Survey, and have been of great service to the writer. Mr. Stanton, of the Geological Survey, has also sent many fossils for inspection.

The author's works and field notes on this stage in Arkansas and Texas.—The results of the author's work on this terrane in Arkansas, are embodied in vol. ii, of the Ann'l Rep't Geol. State Survey of 1892. The Midway and other Tertiary molluscan remains of Texas were fully described and figured in a large monograph prepared to accompany the Fifth Annual Report of the State Survey; but appropriations failed and the work remains unpublished as a whole; the new species were brought out in 1895 by the Philadelphia Academy of Natural Sciences in the "Proceedings." A few field notes and many paleontological facts are published for the first time in the present work.

PART I. GEOLOGY.

BRIEF HISTORICAL SKETCH OF THE STUDY OF THE MIDWAY STAGE.

Period of 1834-1859.

Featherstonhaugh.—So far as we are aware, the first account of beds belonging to the Midway stage was given by G. W. Featherstonhaugh in 1835.* He says that at Little Rock, Arkansas, he "found a calcareous deposit containing marine fossil shells† belonging to the Tertiary beds. Three miles west of Little Rock, this deposit reappears in considerable quantities, and is quarried for the purpose of making lime."

Winchell.—The Midway beds about Allenton, Ala., and "eight and a half miles to the north" of that place were studied in 1853 by Prof. A. Winchell and published three years later.‡ He placed them in his "Buff Sand" group and correctly referred them to the Eocene. The fossils he collected were placed in the hands of Prof. Tuomey for description; but unfortunately for science Prof. Tuomey soon died and the Tuscaloosa cabinets were destroyed by fire during the Civil war. Prof. Winchell did not realize any more than most of his successors that his "Prairie Bluff Limestone" on the Alabama river was composite. He regarded it all as Cretaceous.

Harper.—While State Geologist of Mississippi, Dr. Harper§ mapped the Midway area in Tippah county and very correctly referred it to the Eocene, but drew extremely arbitrary boundary lines along its southern and western sides.

It will be noticed that in this period most observers of terranes belonging to what we now designate Midway, referred

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*Geological Report of an examination made in 1834 of the elevated country between the Missouri and Red rivers, by G. W. Featherstonhaugh, U. S. Geologist, published by order of both houses of Congress, Washington; printed by Gales & Seaton, 1835, 8vo, 97 pp. section. See p. 60.

† "*Ostrea, Turritella, Calyptrea, Cerithium, &c.*"

‡ Proc. Amer. Ass. Adv. Sci., vol. x, 1856, pp. 89-90; Science, vol. iii, 1885, p. 32.

§ Preliminary Report on the Geology and Agriculture of the State of Mississippi, by Dr. L. Harper, LL. D., Correspondent of the Imperial Museum for Nat. Science of France, etc., State Geologist of Mississippi. By order of the Legislature of Mississippi, E. Barksdale, State Printer, Jackson, 1857, 8vo, 350 pp., 7 pl., 1 map. See p. 36 and pl. 7.

them to the Eocene series. We now are about to enter upon a period when for some unknown reason geologists and paleontologists were prone to refer such deposits to the Cretaceous.

Period of 1860-1883.

Hilgard.—In Hilgard's Geological Report of 1860* numerous references are made to the Midway deposits in Tippah Co. The limestone he refers to the Ripley Cretaceous, while the clays he regards as Lignitic or Lower Claiborne Eocene.

Gabb.—In the same year Gabb† described specimens from Hardeman Co., Tenn., sent him by Safford as Ripley fossils. They were all from localities near Middleton.

Safford.—In 1864 Dr. J. M. Safford published an article‡ "On the Cretaceous and Superior Formations of Tennessee." He gave therein an outline map and section showing the exact localities whence he obtained the fossils sent to Gabb, and regarded them all as Cretaceous. His Porter's Creek group he referred to the Tertiary with a query.

Loughridge.—In the reports of the 10th Census Mr. R. H. Loughridge recorded many geological observations. He noted (vol. v, 1882-3, p. 679) the occurrence of Tertiary fossils, now known to be of Midway age, in the Tehuacana hills of Texas.

On p. 280 of vol. vi, he gave a section of the bluff at Fort Gaines, Ga., and referred the Midway limestone in the same to the Claiborne stage.

White.—Dr. C. A. White called attention to a series of fossils sent to the U. S. National Museum (See Proc. of, vol. iii, p. 161), by Mr. Ulrich from near Little Rock, Arkansas. He regarded them as representing a Cretaceous fauna.

Later, Bull. No. 4, U. S. Geol. Surv., he made still further remarks on this fauna, describing some of the new species. They were still regarded as of Cretaceous age.

We see from the above that the observations on the Midway stage during this period were not many nor were the correlations made, accurate.

Period of 1884-1896.

Johnson.—Through the co-operation of the United States Geol.

* Report on the Geology and Agriculture of the State of Mississippi, by Eug. W. Hilgard, Ph. D., State Geologist. Printed by order of the Legislature, E. Barksdale, State Printer, Jackson, Miss., 1860, 8vo, 391 pp., map and sections. See pp. 85, 87, 109.

† Jr. Ac. Nat. Sci., Phila., vol. iv, 1860, p. 389, *et seq.*

‡ Am. Jr. Sci., vol. xxxvii, 1864, p. 360.

Surv. and the Geol. Surv. of Alabama, Mr. L. C. Johnson was sent into the north Tertiary regions of Alabama and as early as 1883 (Science, vol. ii, p. 777; iii, p. 32) began to realize the fact that the Tertiary–Cretaceous border line was considerably farther to the north, in some localities at least, than was then generally conceded. In other words he re-discovered Winchell's discovery.

Smith.—However, the first publication containing anything like a satisfactory discussion of any section of the Midway stage, was that by Dr. Eug. A. Smith and L. C. Johnson, published as Bulletin No. 43 of the U. S. Geol. Surv., 1887.

We shall see hereafter how this classic work must be considerably modified in many ways to meet the demands of subsequent observations, but the main points in the stratigraphy of our lower Eocene are there well set forth.

Penrose.—While engaged on the Texas Geological Survey, Mr. R. A. F. Penrose (See 1st Ann'l Rep't Geol. Surv., Texas, 1889), described certain lower Eocene formations under the name of Basal or Wills Point clays. He made little or no attempt to accurately locate them in the scale of Eocene beds farther east.

Langdon.—In 1890, Mr. D. W. Langdon, jr., read before the Geological Society of America a paper entitled, "Variations in the Cretaceous and Tertiary strata of Alabama."* He therein gave many important facts regarding the Midway stage, particularly as it crops out along the Chattahoochee river. He corrected Loughridge's erroneous reference of the light-colored, impure limestone at the base of Ft. Gaines bluff to the Claiborne stage. The substance of this paper is repeated in Rep't Geol. Surv. Ala., 1894, p. 368, *et seq.*

Spencer.—In his First Report of Progress, 1891, Mr. J. W. Spencer, State Geologist of Georgia, published a geological map of the southwestern part of the State and indicated thereon the distribution of the Midway as well as other stages. A brief account is given on pages 44-46 of the Midway in this State. From a consideration of our own observations and collections about Americus and Andersonville, we are led to doubt the correctness of Mr. Spencer's conclusions regarding the Midway stage both as shown on the map and as expounded on the pages just referred to. However, another summer's work will determine matters more definitely.

Safford.—A very brief note was published by Dr. J. M. Safford in the Bulletin of the Geological Society of America, vol. iii, 1892, p. 511, on the "Middleton formation" of Tennessee, Mississippi and Alabama. He states that from specimens seen

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*Bull. Geol. Soc. Am., vol. ii, pp. 587-606, July 8, 1891.

in a collection at Oxford, the site of the University of Mississippi, he was able to say that the beds whence they came, (Reeve's, Tippah Co.), are identical with deposits about Middleton, Tenn., and he proposes for them the name of "Middleton formation."

Judging from a letter received from Dr. Safford, Feb. 25, 1896, we conclude that it is the grayish, calcareous clays with green grains as exposed at Hannah's and Huddleston's near Crainesville, at Middleton, at Reeve's and at Blue Mt., that the Doctor would include in his newly named formation. The old localities, two miles east and two miles south of Middleton whence the Gabb specimens were derived, are not definitely correlated.

Harris.—The winter of 1891-2 was spent by G. D. Harris in studying the Tertiary of southern Arkansas. The results of this study were embodied in vol. ii, Ann'l Rep't Geol. Surv., Ark., for 1892; the report, however, was not published and distributed until June, 1894. The Midway stage of that State was therein discussed and several observations regarding the same formation in different States were moreover given. The writer called attention (l. c., p. 23) to the probable Midway age of the Tippah Co. rocks referred by Hilgard to the Silicious Claiborne. The Midway formation in Texas was identified by means of fossils obtained by the U. S. Geological Survey from near Webberville on the Colorado river and in Kaufman county.

Aldrich.—In the latter part of the summer of 1894, Mr. T. H. Aldrich published a short account of the Midway fauna of Alabama in the report for that year of the State Geologist. He described several new species as will appear later on.

In June, 1895, Mr. Aldrich published in Bull. Am. Pal., No. 2, several new molluscan species from the Eocene of Alabama. A few were from Matthews' Landing and hence from the upper part of the Midway stage.

Stratigraphic Nomenclature.

Synonymy.

Beds now recognized as belonging to the Midway stage have hitherto been referred to as—

Buff Sand, Winchell, Proc. Am. Ass. Adv. Sci., vol. x, p. 89, 1856.

Basal or *Wills Point Clays*, Penrose, 1st Ann'l Rep't Geol. Surv., Tex., 1890, p. 19.

Black Bluff division of the Lignitic, Smith and Johnson, Bull. U. S. Geol. Surv., No. 43, p. 18, 1887.

Claiborne, Loughridge, 10th Census, vol. vi, p. 280, 1884.

Clayton, Langdon, Bull. Geol. Soc. Am., vol. ii, p. 594, 1891.

Clayton (*Midway*), Smith, Johnson, Langdon, Geol. Surv. Ala., 1894.

Cretaceous, White, Proc. U. S. Nat. Mus., vol. iii, p. 161, Bull. 4, U. S. Geol. Surv.

Eolignitic, Heilprin, Proc. Ac. Nat. Sci., Phila., 1881, p. 159.

Flatwood's Clays, etc., Hilgard, Agr. and Geol. Miss., pp. 110, 111, 1860.

?Hickman, Loughridge, Rep't Jackson's Purchase Region, 1888, p. 18, Geol. Surv. Ky.

Lignitic, Smith and Johnson, Bull. 43, U. S. Geol. Surv., 1887.

Lignitic or *Siliceous Claiborne*, Hilgard, Agr. and Geol. Miss., pp. 108, 109, 111 and map.

Matthews' Landing division of the Lignitic, Smith and Johnson, Bull. 43, U. S. Geol. Surv., 1887.

Middleton formation, Safford, Bull. Geol. Soc. Am., 1892, p. 511.

Midway division of the Lignitic, Smith and Johnson, Bull. 43, U. S. Geol. Surv., 1887, p. 18.

Midway, distinct from, and of co-ordinate rank with the Lignitic, Harris, Ann'l Rep't Geol. Surv. Ark., 1892, pp. 8, 9, 22.

Midway or *Clayton*, see *Clayton*.

Monterey, Langdon, Bull. Geol. Soc. Am., vol. ii, pl. 23.

Naheola division of the Lignitic, Smith and Johnson, Bull. 43, U. S. Geol. Surv., 1887.

Porter's Creek group, Safford, Am. Jr. Sci., vol. xxxvii, 1864, p. 368.

Ripley Cretaceous, Hilgard, Agr. and Geol. Miss., pp. 85, 87, 1860; Gabb, Jr. Ac. Nat. Sci., Phila., vol. iv, p. 389, 1860; Safford, Am. Jr. Sci., vol. xxxvii, 1864, p. 367; Langdon, Bull. Geol. Soc. Am., vol. ii, pl. 23, (Alabama river section).

Ripley formation, Smith, Johnson and Langdon, Geol. Surv. Ala., 1894, in Prairie Bluff and Pine Barren sections.

Sucarnochee or *Black Bluff* division of the Lignitic, Smith, Johnson and Langdon, Geol. Surv. Ala., 1894, p. 27.

Tertiary (*Eocene*), Featherstonhaugh, Geol. Rep't of the Elevated Country between the Missouri and Red rivers, p. 60. See also p. 39.

Usage of the term Midway.

Priority.—When looking over the above synonymy, one cannot help being impressed with the fact that *Midway* was the first unobjectionable term used to designate any considerable part of the series of deposits here under discussion; and which designated at the same time, within a fair degree of accuracy, their stratigraphic position in the Eocene scale.

The term *Buff Sand* is certainly objectionable for many reasons; other terms like *Flatwoods Clays* and *Porter's Creek group* were not sufficiently defined stratigraphically or paleontologically to merit permanent usage.

Location, geographically and stratigraphically.—Midway is the name of a plantation and landing on the west side of Alabama river about five miles below Prairie Bluff, in Wilcox county. It is said to have derived its name from the fact that river men regarded it as midway between Mobile and Montgomery. The beds exposed along the low bluff at this place consist of impure limestone ledges carrying rather sparsely at different places the "Turritella" and "Enclimatoceras" faunæ. These beds dip gradually to the south and where they reach the river's surface they are overlapped by black clays bearing the Black Bluff fauna. Down the river there is doubtless something like a hundred feet of clayey deposits above these limestone layers, while to the north and below there is nearly an equal amount of calcareous sand and clay. Hence the landing is accidentally in the medial part of the stage.

Differentiation from the Lignitic.—The writer made bold to suggest in his Arkansas report for 1892, (vol. ii, pp. 8, 9), that facts warranted the co-ordination of the terms Lignitic and Midway, *i. e.*, that the latter should no longer be regarded as a subdivision of the former. He also suggested including the Matthews' Landing and Black Bluff clays in the Midway stage. Further observation confirmed these views and in a subsequent publication (Am. Jr. Sci., vol. xlvii, p. 304, 1894) a tabular view of the Eocene beds was given. Practically the same he included in the fourth edition of Dana's Manual of Geology.

The publication of the State Geological Survey of Alabama in 1894 co-ordinated the two terms Lignitic and Midway, but limited the latter to the "Enclimatoceras limestone" and "Turritella limestone" and intermediate layers.

The Midway stage, a stratigraphic and paleontologic unit.—Having now studied this stage in six States, the writer feels at liberty to make a few suggestions as to what ought to be included within its limits, and what should be referred to preceding and what to subsequent stages.

We should take in all such cases some section or locality as typical, with which to compare all others. Perhaps the "Oak Hill–Pine Barren" section given in our description of the geology of Wilcox Co., Ala., will best serve this purpose. Bed 9, (Matthews' Landing horizon), is the first that can at present be positively located; for the lignitic sands above seem to be devoid of molluscan remains but suggest a close affinity with the Lignitic.

Besides many more or less characteristic Midway forms, the writer has collected from this horizon *Enclimatoceras ulrichi*, *Yoldia ebrea*, *Venericardia alticostata* var., *Calyptrophorus velatus* var. *compressus*, all of which descend to the very base of the Midway, and *Isocardia mediavia*, found (rarely) in several Midway beds, and the peculiar type of *Volutilithes* so characteristic of this stage, including *V. limopsis*, *V. rugatus* var. *saffordi*.

The failure to recognize the Matthews' Landing horizon as belonging to the Midway is due to the lack of paleontological facts. To show how great the want of such information has been perhaps one example will suffice. In the Report of the Alabama Survey for 1894, p. 247, we find under *Enclimatoceras ulrichi* White, the statement, "Found only in the Nautilus rock," meaning thereby bed 17 of the section in question. Now that we have collected well-preserved, or at least specifically identifiable, specimens of this species through the whole stage, a range of about 200 feet, including nearly 100 feet of the so-called "Ripley Cretaceous" of that report, we realize that the field has not been very thoroughly surveyed either geologically or paleontologically, and hence we feel at liberty to follow the facts brought out by our own research regardless of statements published previously by others.

Lithologically the Midway beds are subject to rapid changes. We have seen a firm limestone grade out laterally within a few yards into an incoherent sand. What is black clay on one river is often represented by calcareous layers on another; but upon the whole the lower beds of the stage are sandy, clayey and calcareous, while the upper are generally clayey. The Lignitic above is characterized by lignitic sands.

GEOLOGY OF THE MIDWAY STAGE IN DIFFERENT STATES.

Texas.

Rio Grande section.—The exact limits of the Midway stage along the Rio Grande are not known. Its very existence may be questioned, yet from the few unsatisfactory fossils we have seen from there, and the publications of Messrs. Dumble* and Penrose,† we are inclined to believe that it reaches the river at a point about 3 miles below the Maverick-Webb county line.

Before passing to the Colorado river section we should note the peculiar fauna, Midway in part at least, found by Dr. White, 18 miles southeast of Eagle Pass. It consists of

*Jr. of Geol., vol. ii, 1894, p. 555.

†1st Ann'l Rep't Geol. Surv. Texas, 1890, p. 13.

"*Cucullæa macrodonta* [perhaps *saffordi*], *Pectunculus*, *Venericardia* [pl. 5, fig. 3], *Cardium* [pl. 6, fig. 3]." "The shelly matter of these species is completely crystallized." "The matrix was evidently a calcareous light sand or sandstone."—Harris, Ann'l Rep't Geol. Surv. Ark., vol. ii, 1892.

Colorado river section.—"Near Webberville, Travis county, on the Colorado river below Austin (Station 2438) Mr. Stanton found a clayey limestone more or less streaked with brown and yellowish shades but usually of a light yellowish hue. Chocolate colored, silicious pebbles, generally cuboidal in form, are often found in the more clayey beds. The enclosed shells, nearly always crystalline, are *Cucullæa macrodonta* [*saffordi?*], *Venericardia*, *Venericardia planicosta*, *Crassatella* [*C. gabbi*], *Lithodomus*, *Volutilithes?*, coral, sharks' teeth."

From a well at Elgin in the northern corner of Bastrop county, Mr. Dumble obtained *Volutilithes limopsis* and *Pleurotoma anacona*.—Harris, MS. Rep't on Tex. Tert.

Brazos river section.—On this river the contact of the Midway with the underlying Cretaceous is well exhibited in a bluff about where the southeast line of the Hogan Survey crosses the river, or perhaps 1½ miles above the Falls–Milam county line. This bluff is about 200 yards long and where the best outcrop occurs it shows at the base 14 feet of Cretaceous, containing *Baculities*, *et al.*, then 1 foot of material of doubtful age, and above, an unweathered bed of Eocene 4 feet thick with *Calyptrophorus velatus*, *Aporrhais* sp., *Turritella alabamiensis*, *Venericardia alticostata*, *Crassatella gabbi*, *Yoldia eborea*. Above this bed is one of yellow, weathered Eocene 1 foot thick; above are gravels and sands 3 feet in thickness.

About one-half mile below this bluff good exposures occur exhibiting *Ostrea pulaskensis*, *Enclimatoceras ulrichi*, *Calyptrophorus velatus*, *Cucullæa*, *Turritella alabamiensis*, *Yoldia eborea*.

A mile further down-stream or near the Falls–Milam county line there is a high bluff about ¼ mile in length which in some places contains numerous molluscan remains. In its upper portion yellowish sands prevail, then calcareous sandy layers appear, grayish in color, containing *Venericardia alticostata* and *Cucullæa macrodonta*. Below, the sands are bluish and clayey, and the lower portion of the bluff is composed of bluish black clays breaking with conchoidal fracture and containing *Calyptrophorus velatus*, *Cucullæa macrodonta*, *Crassatella gabbi* (see pl. 5, figs. 10 and 11), *Yoldia eborea*, *Turritella nerinexa*.

A few miles farther down-stream, at a locality heretofore spoken of as "2 miles above the mouth of Pond creek" and near the residence of Mr. Smiley, another bluff ¼ mile in length appears.

Its beds show a decided dip in some places while in others they appear horizontal. It is mainly composed of sandy material, specked with fragments of lignite and containing numerous calcareous boulders especially toward its northern end. Here, too, fossils were found from the water's edge to a height of about 11 feet. They are *Ostrea crenulimarginata*, *Leda milamensis*, *Cerithium penrosei*, *Pleurotoma ostrarupis*, *Pl. anacona*, *Fusus ostrarupis*, *Pseudoliva ostrarupis*, *Pseudoliva ostrarupis* var. *pauper*.

Falls county.—Farther east, in Falls county, the Midway limestone crops out along Salt Branch of Little Brazos river, on the Dennis Herald survey. About ½ mile above the confluence of the two streams, specimens of *Venericardia planicosta*, *V. alticostata*, *Enclimatoceras ulrichi* have been collected, and ½ mile still farther up the Branch, *Mesalia pumila* occurs.

Limestone county.—This county furnishes many Midway exposures and from them the members of the Texas Survey collected various characteristic fossils. A locality known as Horn Hill has furnished *Venericardia planicosta*, *Ostrea crenulimarginata*, *Modiola saffordi*, *Turritella humerosa* var. *eurynome* or *bellifera*.

In the vicinity of Tehuacana the limestone beds of the Midway aggregate at least forty feet. They are overlaid by yellowish and bluish, slightly argillaceous sandy layers which so far as observed are unfossiliferous. West of the College, say ½ mile, yellowish, calcareous sands occur forty-five feet or more below the base of the limestone and contain among many indefinite fossil remains fairly well preserved imprints of *Turritella mortoni* var. The same fauna is found in dense black clay, 1½ miles north of the College for a distance of 70 feet below the limestone. Other fragmentary specimens of *Pleurotoma*, *Nautilus?* and *Aporrhais* were seen here by the writer. Large calcareous boulders are of frequent occurrence in this horizon.

So far as known there are no specimens of *Cucullæa* in the immediate vicinity of Tehuacana, though several specimens of *Ostrea crenulimarginata* and *Turritella humerosa* var. have been collected. A large *Enclimatoceras ulrichi* in the College Museum is labelled *Nautilus danicus*.

The dip of this limestone formation varies considerably. In some instances it rises to a pitch of 45 degrees and is generally in a south-southeast direction.

Kaufmam county.—Going along the railroad from Wills Point westward for about two miles one finds some good exposures of laminated bluish and yellowish clays, calcareous nodules and boulders. Lignitic and micaceous specks are not uncommon. No fossils were here observed. Five miles west of Wills Point

on Rocky Cedar creek the Midway limestone layers contain *Ostrea pulaskensis*, *Venericardia alticostata*, *Venericardia planicosta*, *Crassatella gabbi*, *Pleurotoma anacona*, *Pseudoliva unicarinata*, *Fulguroficus*.

From this county, at a station numbered 2440 in the U. S. Nat. Museum register and designated as four miles northeast of Kemp, Mr. Stanton collected *Cucullæa saffordi?*, *Cytherea*, *Venericardia planicosta*, *Turritella mortoni* and *Natica alabamiensis*, (Ann'l Rep't Geol. Surv. Ark., vol. ii, 1892, p. 33).

Arkansas.

Hot Springs county.—Passing into Arkansas, the first known fossiliferous Midway outcrop is to be found in the S. W. ¼ of S. 17, 4 S., 17 W. It contains among other less recognizable fossils *Cucullæa saffordi?*, *Turritella mortoni* and *Venericardia* sp. A well at the site of old Rockport passed through Midway limestone.

Saline county.—In the northeast corner of the northwest quarter of the northeast quarter of section 2, 3 S., 16 W., fossils are imbedded in a light bluish, sandy and clayey limestone and include *Ostrea pulaskensis*, *Cucullæa saffordi*, *Yoldia eborea*, *Nucula*, *Venericardia*, *Crassatella gabbi*, *Protocardia nicolletti* var., *Corbula subcompressa*, *Turritella humerosa?*, *Volutilithes limopsis?*.

In the northwest quarter of the northeast quarter of section 36, 2 S., 16 W., a very light yellowish sandy limestone furnished *Ostrea pulaskensis*, *Cytherea* sp., *Venericardia planicosta*, *Protocardia* sp., *Crassatella gabbi*.

In the northeast quarter of the southeast quarter of section 18, 2 S., 15 W., the following forms have been found: *Ostrea crenulimarginata*, *Yoldia eborea*, *Cytherea*, *Venericardia planicosta*, *Turritella multilira?* and a *Volutilithes*.

In a bluish, argillaceous limestone matrix, in the southeast quarter of the northwest quarter of section 15, 1 S., 14 W., *Ostrea crenulimarginata* and *pulaskensis* have been found.

From a highly ferruginous sandstone in the southwest quarter of the southeast quarter of section 9, 1 S., 14 W., fragments of casts of *Venericardia planicosta* and *Turritella mortoni* have been obtained.

Pulaski county.—Perhaps the best or most fossiliferous Midway exposure in Arkansas is one long ago described by Owen as on Fourche creek near the mouth of Crooked Creek, only a few miles southwest of Little Rock. This is in the northwest quarter of the southwest quarter of section 8, 1 S., 13 W., not far from Olsen's switch. Ulrich, Drake and Harris have collected fossils from this vicinity, and they have been described by Dr. C. A. White and G. D. Harris. The section here represented is as follows:—

a. Soil.

b. Enclimatoceras limestone: yellowish and gray, more or less friable; exterior of fossils often stained brown by iron oxide; replete with *Enclimatoceras ulrichi*, varying in size from 1 to 12 inches in diameter; 18 inches.

c. Ostrea limestone: compact, light gray limestone, containing innumerable specimens of *Ostrea pulaskensis*, 3 feet.

d. Turritella limestone: light yellowish and gray, somewhat sandy; often honey-combed and cavernous, weathering very irregularly; at base especially, replete with *Turritella mortoni*, - - - - 8¼ feet

e. Sandstone ledge, light yellowish; formed apparently by infiltration of waters charged with calcite, into sand like that below, - - - - 2¾ feet.

f. White, compact sand, tinged yellowish on the exterior; contains scattering blue nodules. Exposed, 2 feet.

g. "Black slate, lying nearly horizontal; seen only at times of very low water."—Olsen.

The molluscan species are *Enclimatoceras ulrichi*, *Ostrea crenulimarginata*, *O. pulaskensis*, *Cucullæa saffordi*, *Yoldia eborea*, *Crassatella*, *Venericardia planicosta*, *Protocardia*, *Cytherea* (*Dosiniopsis?*), *Corbula subcompressa*, *Tornatellæa* cf. *bella*, *Calyptrophorus velatus*, *Volutilithes* probably *saffordi*, *Pyrula*, *Mesalia alabamiensis?*, *Turritella mortoni*, *T. alabamiensis*, *T. multilira*, *Scala* sp., *Natica alabamiensis*.

Farther to the southwest about ½ mile a compact gray limestone appears in the bed of a stream just north of the railway track. This has furnished specimens of *Cucullæa saffordi*, *Cytherea* (*Dosiniopsis*), *Crassatella*, *Venericardia planicosta* (large), *Calyptrophorus velatus*.

In Little Rock, from Capitol Hill to the County Hospital, Midway limestone is frequently met with. The best collections made by the Arkansas Survey were from Johnson's well on Capitol Hill. Some were imbedded in light clayey, crystalline limestone, while others were from more yellowish and sandy layers. The forms identified are *Ostrea crenulimarginata*, *Cucullæa saffordi*, *Meretrix* sp., *Venericardia planicosta*, *Protocardia*, *Tornatellæa*, *Volutilithes* probably *saffordi*, *Mesalia alabamiensis*, and large typical *Turritella mortoni*.

Featherstonhaugh records from this limestone at Little Rock, *Ostrea*, *Turritella*, *Calyptrea*, *Cerithium*, *etc.*

Lonoke county.—In the vicinity of Cabot this limestone has been seen and it has furnished a few Midway species.

White county.—Again, perhaps 1¾ miles north of Bradford, a

few Midway specimens have been collected in limestone quarries near the railway.

Jackson and Independence counties.—Three miles north of Bradford and at Grand Glaise extensive limestone exposures are found, but they are often rather barren. At present the existence of similar deposits beyond Bayou Departe are unknown.

Tennessee.

Omitting all discussion of deposits in Kentucky presumably of Midway age since they have not been studied by the writer personally, the first outcrops east of the Mississippi to receive special attention are those near Crainesville, Hardeman Co., Tennessee.

Vicinity of Crainesville.—About 1¾ miles north of this village there are several fossiliferous exposures near Mr. Hannah's house. In the yard and along the roadside in front of this house the following sequence of strata was noticed:—

a.	Sand bed clayey at base; highest Eocene deposits seen in the vicinity,	10-20 feet.
b.	Whitish sandstone; fossiliferous,	8 inches.
c.	Clays,	10-15 feet.
d.	Clay-stone with green grains; *Venericardia* bed,	14 inches.
e.	Clay with peculiar sandstone concretions,	15-20 feet.
f.	Clay; gray and very fossiliferous above (*Leda*, *Tellina*, *etc.*); darker medially and almost black at base; lowest bed seen in the vicinity,	25 feet.

Bed *b* contains *Venericardia planicosta* var., *Calyptrophorus velatus*, *Enclimatoceras ulrichi*, *Protocardia* var. of *nicolletti*, *Ostrea pulaskensis*, *Cucullæa saffordi*, *Turritella mortoni*, *Crassatella gabbi*, *Modiola saffordi*, *Volutilithes rugatus* var. *saffordi*, *Yoldia eborea*, *Pholadomya mauryi* and several indeterminable fragments.

Bed *d* is evidently the one from which Johnson obtained his specimens for the U. S. National Museum about ten years ago. Casts of *Venericardia* probably var. *smithi* are extremely abundant in this bed.

Bed *f* is very fossiliferous in its upper part; among others it has furnished *Yoldia kindlei*, *Leda milamensis*, *Tellina* (pl. 6, fig. 8), *Corbula subcompressa* and *Tornatellæa quercollis?*.

Bed *e* just above the last mentioned is composed of clay in which there are numerous hard sandstone concretions. They vary greatly in size, and lie at all angles to the lines of bedding, being often vertical—dyke-like—through several feet of deposition.

Bed *f* when traced downward in the ditches at the side of the road represented in Fig. 1 becomes nearly black and shows a few poorly preserved specimens of *Turritella mortoni* var.

Though we went over a mile east of this locality we met with

FIG. 1.— MIDWAY EXPOSURE AT R. HANNAH'S, 1¾ MILES NORTH OF CRAINESVILLE, HARDEMAN CO., TENN.

The hard ledge traversing the road is bed *d* of the section on p. 18.

no Cretaceous outcrops.

One-half mile southwest of Hannah's, bed *d* is well exposed and shows a local dip of about 1 foot in 20. The fossils obtained here consisted of casts; in fact, no fossils were collected by us in Tennessee which retained any considerable amount of their shelly substance. As nearly as we are able to determine such material, the species represented are *V. planicosta* var., *Crassatella gabbi*, *Calyptrophorus velatus* and what seems to be an internal impression of *Ostrea crenulimarginata*.

In and near the road at Mr. Huddleston's, 3 miles west of Crainesville, the following section was observed:

a.	White sandstone (fossiliferous),	1 foot.
b.	Clay,	20 feet.
c.	Clay-stone with green grains (fossiliferous),	2 feet.
d.	Clay,	15 feet.
e.	Clay-stone with green grains (fossiliferous),	1 foot.
f.	Clay,	?

It will be observed that the upper part of this section corresponds well with that at Hannah's and is doubtless its equivalent.

In the upper bed of the gray clay-stone with green grains the following forms were collected: *V. planicosta* var., *Ostrea pulaskensis*, *Pholadomya mauryi*, *Tellina*, *Cucullæa saffordi*, *Crassatella gabbi*, *Calyptrophorus velatus*, *Yoldia eborea*, *Natica* sp.

The clay layer "*d*" yields impressions of *Leda milamensis* and *Tellina* as bed "*f*" at Hannah's does.

Five miles south of Crainesville a hillside about 400 yards west of the highway is strewn in some places with ferruginous blocks of sandstone containing many impressions of *Venericardia* and *Pectunculus* (See pl. 4, fig. 3). The land is owned by Mr. Markham.

Middleton and vicinity.—Reference has already been made (p. 8) to the fact that as early as 1860 Dr. Safford sent Gabb of the Philadelphia Academy some fossils from the neighborhood of Middleton, Hardeman Co., Tenn. More particularly these fossils were derived from three exposures*; one, "a bed of buff gray, impure limestone from 2 to 6 feet thick. It is found on both sides of the railroad near Muddy creek." "It is doubtless the 'Turritella' and 'Bored' limestone of Hilgard's sections Nos. 12, 13 and 14; pp. 86-88." The other localities show "clayey sand with green grains," and are two miles east and about two miles south-southeast respectively from Middleton.

Safford following Gabb's identifications gives a list of fossils from these localities as follows,—*l* being the limestone exposure

* Safford's Geol. of Tenn., 1869, pp. 418-19.

and *s* the clayey sand bed:

1. *Corbula subcompressa* Gabb, - - - *s.*
2. *Venus ripleyana* Gabb, - - - *l, s.*
3. *Crassatella pteropsis* Gabb, - - - *l, s.*
   (Conrad had previously given this name to a species of *Crassatella;* Jour. Phila. Ac. iv, 279. I [Safford] therefore propose *C. gabbi* for it.
4. *C. monmouthensis?* Gabb, - - - *s.*
5. *Cardita subquadrata?* Gabb, - - - *s.*
6. *Leda protexta* Gabb, - - - - *s.*
7. *Modiola saffordi* Gabb, - - - - *l, s.*
8. *Ostrea denticulifera* Con., - - - *l. s.*
9. *O. crenulimarginata* Gabb, - - - *s.*
   (If No. 8 is referred to the proper species, then *O. crenulimarginata* Gabb is, I [Safford] think, its lower or larger valve.
10. *Gryphæa vomer* Mort., - - - *l.*
11. *Turritella tennesseensis* Gabb, - - - - *s.*
12. *T. saffordi* Gabb, - - - - *l, s.*
13. *T. hardemanensis* Gabb, - - - - *s.*
14. *T. pumila* Gabb, - - - - *l, s.*
15. *Natica rectilabrum* Con., - - - - *s.*
16. *Fasciolaria saffordi* Gabb, - - - *s.*
17. *Neptunea impressa* Gabb, - - - - *s.*
18. *Callianassa? gwyni* Safford, - - - *l, s.*
19. *Lamna gracilis?* Ag., - - - - *s.*
20. *Crocodilus?* (tooth) - - - - *s.*

"It will be seen that but two species of those given, *Gryphæa vomer* and *Natica rectilabrum*, are common to this group and the Green Sand. Localities in Mississippi, however, furnish series of fossils which unite the groups more intimately."

The *Gryphæa vomer* is doubtless an *Ostrea pulaskensis*, while the *Natica rectilabrum* is not the Cretaceous form described by Conrad under that name; this has been ascertained by a comparison of typical Cretaceous species from Mississippi with Dr. Safford's specimens. By referring to Part II of this Bulletin it will be seen what disposition has been made of the various molluscan species named above.

Specimens from Middleton station kindly forwarded by Dr. Safford show that the Crainesville horizon passes through this place, and, as we learn from other sources, passes through Tippah and Pontotoc counties in Mississippi. Dr. Safford's Middleton specimens include *Cucullæa saffordi*, *Meretrix ripleyana*, *Venericardia* var. of *planicosta*, *Turritella mortoni*, *Fusus hubbardanus*, *Calyptrophorus velatus and Levifusus trabeatus* var.

From Porter's creek Mr. Johnson obtained fragmentary specimens of what appear to be *Ostrea crenulimarginata*. He says on a slip of paper accompanying the specimens, "Extending from Middleton, Tenn., several miles westward lies the Porter's creek formation of Safford." Hence we are led to believe that the greater part of Safford's Porter's creek group belongs to the Midway.

The typical Crainesville–Middleton beds and fauna were found by Johnson at a locality designated as McDonald's mill, 4 miles southwest of Middleton. The various species he collected will be referred to in their proper places under Part II.

Mississippi.

Walnut and vicinity.—In crossing the Mississippi line going south from Middleton one finds the peculiar calcareous gray, green specked, hardened clays of the Crainesville horizon outcropping on the place described by Hilgard in his Agriculture and Geology of Mississippi, p. 112, as the Reeve place. This is about 2½ miles northwest of Walnut. Mr. Hubbard made a

FIG. 2.— CHALYBEATE SPRING, TIPPAH CO., MISS.

collection here which included *Venericardia planicosta* var., *Cucullæa saffordi*, *Cassatella gabbi*, *etc.*

At Chalybeate, two or three miles east of Walnut, a Midway limestone appears bearing *Turritellæ* in abundance. The spring (Fig. 2) from which this place takes its name issues from immediately beneath this limestone or from the Cretaceous Owl creek marl. The limestone layer was not all seen in any one section, but did not appear to have a maximum thickness of over 10 feet. Ferruginous sands at least 20 feet thick were seen to overlie this limestone. In but one place in the vicinity were fossils observed in this arenaceous deposit. They consisted of very poorly preserved *Venericardia*.

Farther east, 1½ miles N. N. E. of Chalybeate, on Mr. Bobo's land it was observed that the Midway Turritella limestone was cemented below to a similar appearing rock, but replete with *Baculites* and many other typical Cretaceous forms. The dividing line between the two formations was indicated by a line of coarse pebbles. The lack of care in distinguishing between these two calcareous deposits may have caused Hilgard and others to regard the whole as Cretaceous.

Ripley and vicinity.—The sequence of Midway strata in the vicinity of Ripley is shown in the following section:

a. Reddish sand, omnipresent.
b. Fine, crumbling bituminous shale, as seen on top of hill 1½ miles N. W. of Ripley, - 20 feet.
c. Bed with *Venericardia et al.*, - - 2-4 feet.
d. Light gray and slate colored clay with conchoidal fracture, in places with a few fossils, (Memphis road, leading N. W. from Ripley,) - - 75-100 feet.
e. Light gray, indurated, residual clay containing fine, glauconitic particles, ½ mile N. of Ripley, 4-6 feet.
f. Red, rather coarse sand. - - - 25 feet.
g. The Turritella rock of Safford, ½ mile S. of Ripley, and also many points 1 to 2 miles E. of Ripley, resting on Owl creek marl, - 5-10 feet.

It may be here remarked that the Cretaceous group crops out nowhere in the village of Ripley, and its presence is known only from material obtained from wells dug to depths of 20 to 40 feet according to their location. Moreover almost the whole surface of the country for two miles farther east is of Midway Eocene. Hence the name *Ripley group* when applied to the uppermost Cretaceous is to some extent misleading. The famous Ripley (Owl creek) exposures are about 3 miles to the northeast.

At the forks of the road leading southward from Ripley, perhaps ½ mile south of the Court House, a bluff occurs made up of

bed *g* and bed *f* commingled with bed *a*. Following the left fork of the road for a few yards a spring is seen issuing from beneath bed *f*. After a considerable amount of digging, Mr. Hubbard succeeded in finding traces of Cretaceous fossils in the underlying clay bed. The specimens collected from the limestone include *Venericardia planicosta*, typical and varietal, *Turritella mortoni*, *Cucullæa saffordi*, *Meretrix ripleyana*, *Yoldia eborea*, *Calyptrophorus velatus*, *et al.*

Bed *f* is well exposed in the streets along the eastern border of the village a few hundred yards east of the Court House.

Bed *e* is well exposed in the northern outskirts of the town, and our best collection of fossils was made in a pasture about ½ mile out and to the north. The collection includes *Levifusus hubbardi*, *Volutilithes rugatus* var. *saffordi*, *Turritella mortoni*, *Cypræa*, *Tornatellæa bella*, *Scaphella*, *Calyptrophorus velatus*, *Fusus quercollis*, *Fusus hubbardanus*, *Yoldia eborea*, *Venericardia* var. *smithii*, *Cucullæa saffordi* and *macrodonta?*.

Bed *d* is well exposed along the Memphis road from ½ to 1½ miles from Ripley. It contains a few fossils with shells in the condition of white powder but no large well preserved recognizable ones were noted.

On top of a high hill 1½ miles northwest of Ripley, bed *a* is well exhibited and on either slope a short distance from the summit there are traces of *Venericardiæ*—bed *c*.

At the roadside 1 mile east of Ripley Mr. Hubbard collected *Fusus tortilis?* and *Venericardia alticostata* Con. var., while 1 mile still farther east from a splendid exposure of bed *g* he obtained vast numbers of casts of *Turritella mortoni* along with *Calyptrophorus velatus* var. *Cucullæa saffordi*, *Venericardia planicosta*, *Meretrix ripleyana*, *Ostrea pulaskensis?* and many other less recognizable forms.

Blue Mountain, *i. e.* the Brougher place of Hilgard's report, is six or seven miles to the southwest of Ripley and furnishes a good Eocene section. The various beds exposed with rough estimates of thicknesses are as follows:

a. Top of hill. Ferruginous, large concretions in red sand.

b. 100 feet more or less of reddish sand.

c. Clay bed, perhaps 20 feet thick; being impervious to the waters percolating through *b* it gives rise to many noble springs, the best of which come forth just above the laundry of the flourishing Blue Mountain college.

d. Beneath *c* and around the steeper banks below the spring the first fossiliferous bed is found. It is the typical Crainesville gray calcareous clay with green grains and bearing *Venericardia* var. *smithii*, *Cucullæa saffordi*, *Tur-*

ritella mortoni var., *Meretrix ripleyana*, *Yoldia eborea*, *Protocardia and Enclimatoceras ulrichi;* 2 to 4 feet in thickness.

e. Nearly barren clay; perhaps 20 feet.

f. A repetition of bed *d*.

g. Clay as in bed *e*.

Pontotoc and vicinity.—Material of the same general appearance occurs in the highway from 1 to 2 miles west of Pontotoc; but owing to a slight indisposition on the part of the writer the day that was allotted to its examination, no collections of fossils were made. The exposures in the immediate vicinity of the station carry a typical upper Cretaceous fauna.

Alabama.

Black Bluff.—This bluff according to Smith and Johnson is in S. 12, 16 N., 1 W. (Bull. 43, U. S. Geol. Surv., 1887, p. 61). It is in places about 70 feet high, but as a rule furnishes few and imperfect molluscan remains. The specimens collected by the writer upon first visiting the locality are now in the State Museum at Austin, Texas. They contained a few forms more perfect than those obtained during last summer's visit, and owing to the absence of the State Geologist from Austin they are inaccessible at present. Our collection however shows *Enclimatoceras ulrichi*, *Cucullæa macrodonta*, *Yoldia eborea*, *Nucula mediavia*, *Meretrix* (large, fragment), *Tornatellæa bella*, *Volutilithes rugatus*, *Levibuccinum lineatum*, *Mitra hatchetigbeensis?*, *Olivella mediavia*, *Natica*, *Pleurotoma*, *Dentalium* and other less determinable fragments.

The black clays so characteristic of this exposure and general horizon continue on down the river for several miles, often furnishing a few well preserved fossils but never abundantly. At a locality about 4 miles below the bluff we collected *Enclimatoceras ulrichi*, *Cucullæa macrodonta*, *Yoldia eborea*, *Volutilithes rugatus* var. somewhat like *saffordi*, *Olivella mediavia* and many fragmentary specimens.

Among the molluscan remains in these Black Bluff clays one observes an abundance of coral and crab remains. One inorganic structure attracts attention on account of its pisolitic, light gray appearance. Dr. Gill of this University on testing one of these peculiar substances pronounced it Barite (Barium sulphate). Gypsum crystals are common in the clays; and springs which issue in abundance from many of the exposures are generally very sulphurous and their waters impotable.

Naheola.—Farther down the Tombigbee, at Naheola the black clays reach the water's edge, and the ferruginous green sand

(often indurated) marl is most conspicuous. Immediately at the landing no well preserved fossils were found, but the outcrops perhaps 100 yards below furnished *Cucullæa macrodonta*, *Protocardia nicolletti* var. (large and perfectly preserved), *Astarte smithvillensis* var., *Venericardia alticostata* var., *Pecten alabamensis*, *Meretrix*, *Ostrea*, *Dentalium*, *Pseudoliva unicarinata*, *Volutilithes* var. *saffordi*, *Fusus mohri*, *Natica eminula*, *N. alabamiensis*, *Voluta showalteri*, *Cylichna* (pl. 7, fig. 7).

Prairie Bluff and vicinity.—Prairie Bluff on the Alabama has long been known as a typical upper Cretaceous collecting ground; and strange to relate, from the time of Winchell's visit in the fifties until ours of last summer the Eocene character of the surface rocks on this bluff and its immediate vicinity had never been detected. Smith and Johnson's general section of this locality as published in 1887, in Bull. 43, U. S. Geol. Surv. and 1895 in the State Survey report of that year is reproduced in this treatise along with the Oak Hill–Pine Barren section. Our interpretation of the same is therewith given.

Since this is one of the localities in this part of the State most frequented by collectors, we feel it not out of place to give a considerable number of details in its description.

Our general section taken from outcrops at the Bluff and many others from ½ to 2 miles to the north is given below:

Tops of highest hills to the north of Prairie Bluff. Sandy layers with some clayey limestone. One *Enclimatoceras* observed.

a. Bluish clay with ledges of impure light or slightly yellowish limestone; fossils scarce, - - 15 feet.

b. Very much as in "*a*" but characterized by a *Lucina*, - - - - - - 30 feet.

c. Yellowish gray limestone with *Enclimatoceras*, 1 foot.

d. Bluish clay with bands of impure limestone containing *Enclimatoceras*, - - - 20 feet.

e. Clayey and limy layer with *Enclimatoceras*, *Venericardia*, *Cucullæa*, *etc.*, - - - - 2-3 feet.

f. A continuation of bed "*e*" but becoming more clayey, calcareous and bluish above; below having the texture of brown sugar, or sandy and unfossiliferous, and finally pebbly with rolled *Belemnites* and *Exogyra* fragments, - 8-12 feet.

g. Blue clay with Cretaceous fossils.

The contact of the Midway and Cretaceous beds can be seen at the Bluff in the little channels that cut the surface rocks just south of the cotton storage shed. But the best and most fossiliferous exposures are to be found a mile or two from the landing.

To the north, about one mile, between the first and second hill the basal Eocene and the uppermost Cretaceous beds can be seen in an old field. Cretaceous beds in all instances occupy the brink of the bluffs, but a short distance inland, only a few yards in some instances, Midway beds appear. The uppermost bed of the Cretaceous that certainly has not been rehandled is a layer of hard, bluish micaceous clay about 7 feet thick, generally poor in fossils, resting on a bed replete with *Exogyra* and *Gryphæa*. Reposing unconformably upon the bluish clay layer is a bed of coarse granular friable sandstone; it is coarser below, with quartz pebbles, shark's teeth, rolled fragments of *Belemnites*, *Exogyra*, *etc.* Higher up, this bed grades into bed *e* which is an impure clayey limestone with many specimens of *Enclimatoceras ulrichi*, *Turritella mortoni*, *Crassatella* probably *gabbi*, *Cucullæa* probably *saffordi*, *Ostrea pulaskensis*, *Venericardia alticostata* var., corals, sharks' teeth, *Tubulostium*, *et al.*

In the fields between the second and third hill north of the Bluff it was seen that occasionally all the calcareous layers of bed *d* furnish specimens of *Enclimatoceras ulrichi*. Bed *c* where it outcrops in the highway at the foot of the southern slope of the first hill north of Prairie Bluff furnishes many specimens of this important fossil. On the summit of the third hill to the north, occupying a position 10 or 15 feet above bed *a*, some calcareous rock fragments were found which from their altitude we were inclined to regard as representatives of the limestone ledge seen at Midway. A very large *Enclimatoceras* was obtained from one of these fragments.

Going westward from the Bluff one passes off from the Eocene beds down into a slight depression and there finds numerous *Exogyræ* and other Cretaceous forms. Gradually ascending from this depression and carefully scanning the exposures in the road ditches one finds *Enclimatoceras* quite plentifully.

After going about ¾ mile west from the river along the Catharine road the Cretaceous–Eocene contact can be seen at the roadside. The Eocene bed contains practically the same fauna as that just described from 1 mile north of the Bluff. The fossils collected here are *Enclimatoceras ulrichi*, *Crassatella*, *Cucullæa*, *Ostrea pulaskensis*, *Venericardia alticostata* var., *Yoldia eborea*, *Turritella mortoni*, *Scala*, *Tubulostium*, sea-urchins, and sharks' teeth.

In a field about ⅓ mile northwest from the Bluff, bed *c* furnished *Pseudoliva scalina* and *Turritella nerinexa?*.

In the same old field a few hundred yards nearer the Bluff specimens were obtained of *Enclimatoceras ulrichi*, *Fusus* (large cast), *Turritella mortoni*, *Amauropsis*, *Crassatella*, *Cucullæa*,

Venericardia, *Ostrea pulaskensis* and *O. crenulimarginata*.

In the hill just north of the Bluff numerous specimens of a *Lucina* were obtained. They are usually coated over with a calcareous clayey substance, and oftentimes more or less distorted. Owing to their imperfect state of preservation it is impossible to say for certain whether they belong to species already described or not. Similar specimens have been seen on the Brazos river as well as on the Tombigbee. Accompanying this species are *Enclimatoceras ulrichi*, *Turritella mortoni* var. and *Yoldia eborea*.

The Cretaceous–Eocene contact is well exhibited along Shell creek about 1½ miles southwest of Prairie Bluff. Fig. 3 shows in a general way the irregularity of the upper surface of the light blue Cretaceous sandy clay, and also the coarse pebbly character of the lower layers of the superincumbent arenaceous bed. A section from the bed of this stream to the level of the high land to the south is as follows:—

a. Limestone layers, - - - - 10? feet.

b. Bluish sandy and micaceous clays interspersed with calcareous ledges (beds *a*, *b*, *c* & *d* of the

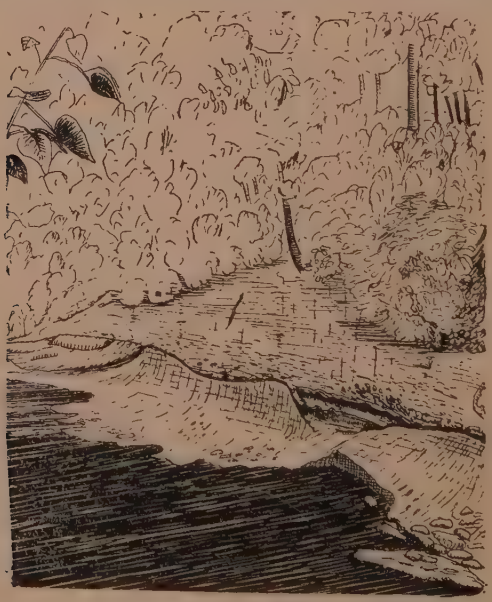

FIG. 3.—CRETACEOUS–EOCENE CONTACT, ON SHELL CREEK, ALA.

section north of Prairie Bluff), - - 80 feet.

c. Bluish sandy clay, somewhat indurated, with *Cucullæa saffordi* and *Ostrea pulaskensis* (bed *e* of section north of the Bluff), about - 7 feet.

d. Transition sandstone with pebbles and rolled fragments of Cretaceous fossils (bed *f* of section north of Prairie Bluff), - - - 10 feet.

e. Cretaceous sandy clay.

Midway and vicinity.—About half-way between the last mentioned exposure on Shell creek and Midway, in fields that are now under cultivation, shelly limestone outcrops appear here and there bearing many organic remains. Their state of preservation is not excellent, but by diligent search fairly good specimens may be found belonging to a large number of genera. In our field notes and in the Museum catalogues we have referred to these outcrops as 1 mile north of Midway. The following are the most numerous forms: *Enclimatoceras ulrichi*, *Venericardia planicosta*, *Venericardia* sp., *Ostrea pulaskensis* var., *Ostrea crenulimarginata* var., *Cucullæa saffordi*, *C. macrodonta?*, *Calyptrophorus velatus*, *Aporrhais*, *Isocardia mediavia*, *Protocardia*, *Tornatellæa bella*, *Volutilithes rugatus* var., *Turritella mortoni*, *Xenophora*, *Trochita*, *Fusus*, *Natica*, *Solarium* and *Mesalia pumila*.

At Midway a low limestone bluff appears on the west side of the river. It may be traced for several hundred yards up and down the river, but yields few well preserved organic remains. At its southern terminus, *i. e.*, where the limestone layers meet the water's surface, black clays appear resting directly upon the limestone and bearing fragmentary, yet determinable molluscan remains. While visiting this spot several years ago the writer noted *Cucullæa macrodonta*, *Dentalium*, *Yoldia eborea* and corals as at Black Bluff on the Tombigbee.

Matthews' Landing.—This is the place referred to long ago by Whitfield as 6 miles below Prairie Bluff on the Alabama river (Am. Jour. Conch., vol. i, 1865, pp. 259-268). Specimens obtained from here are often fragile, but when compared to those from the great majority of the other Midway specimens consisting only of casts, they must be regarded as extremely well preserved. Weathering seems to harden these friable specimens, and hence instead of digging, one finds it to his advantage to devote himself to hunting over weathered material along the whole outcrop. At a moderately low stage of the river the dark Midway clays form an escarpment about 10 feet above the water, level as a floor on top, with a length of perhaps 50 yards and a breadth of 10. On this level surface atmospheric agents year by year prepare large numbers of beautiful fossils for grateful collectors.

Our list of fossils from this locality is far less complete than it would have been had we not met with a serious accident at the moment of departure whereby many of our best specimens were lost in the river. Nevertheless our collection includes *Calyptrophorus velatus* var. *compressa*, *Corbula subcompressa*, *Cucullæa macrodonta*, *Exilia pergracilis*, *Fusus meyeri* var., *Fusus mohri*, *Fusus tortilis*, *Isocardia mediavia*, *Murex matthewsensis*, *Natica eminula*, *N. onusta?*, *N. perspectiva*, *N. reversa*, *Neptunea constricta*, *Olivella mediavia*, *Ostrea* sp., *Pecten alabamensis*, *Pleurotoma adeona*, *P. longipersa*, *P. ostrarupis*, *P. persa*, *Pleurotomella pagodiformis* var. *quercollis*, *P. whitfieldi*, *Pseudoliva unicarinata*, *P. vetusta* var., *Pyropsis perula*, *Pyrula juvenis*, *Solarium* sp., *Strepsidura heilprini*, *Triton showalteri*, *Trochus alabamensis*, *Turritella alabamiensis*, *Turritella mortoni* var. *levicunea*, *Venericardia alticostata* var., *Voluta showalteri*, *Volutilithes limopsis*, *V. rugatus*, *Yoldia eborea*.

Other species are known to have come from this exposure. First of all may be noted Whitfield's *Natica* (*Girodes*) *alabamiensis*, and his problematical *Velutina* (*Otina*) *expansa;* Dall figures and describes from here *Solarium alabamense* and *S. periscelidum;* Meyer, *Cadulus turgidus;* Aldrich, *Cylichna meyeri*, *Fulgur eocense*, *Rissoina alabamensis*, *Leucozonia biplicata*, *Levifusus suteri*. Moreover Aldrich adds to this list *Murex morulus*, *Pseudoliva scalina*, *Levifusus trabeatus*, *Levibuccinum lineatum*, *Melanopsis choctawensis* and other specimens identified simply generically.

Snow Hill and vicinity.—It is in this portion of Wilcox county that the typical Midway section as understood by us is to be found (See p. 31). On the summits of the slight elevations about Snow Hill station, fragments and sometimes large masses of limestone replete with *Turritellæ* may be seen. This we refer with little doubt to bed 19 of the section just cited. In the first shallow railroad cut north of the station *Ostrea crenulimarginata* is abundant and fairly well preserved in a bluish sandy, micaceous clay matrix. It is accompanied by a few-ribbed variety of *Venericardia alticostata*.

Farther north along the railroad, perhaps ½ mile, a second shallow cut is met with, having the same lithological appearance. Its fossils are not rare nor are they abundant or well preserved. They are nearly all in the form of casts, yet they admit of specific identification and are most important for correlation purposes. They include *Venericardia planicosta* (typical), *V. alticostata* (few-ribbed var.), *Ostrea crenulimarginata*, *Meretrix*, *Turritella mortoni* and *Volutilithes saffordi*.

Two miles north of the station, at Rock cut, about 25 feet

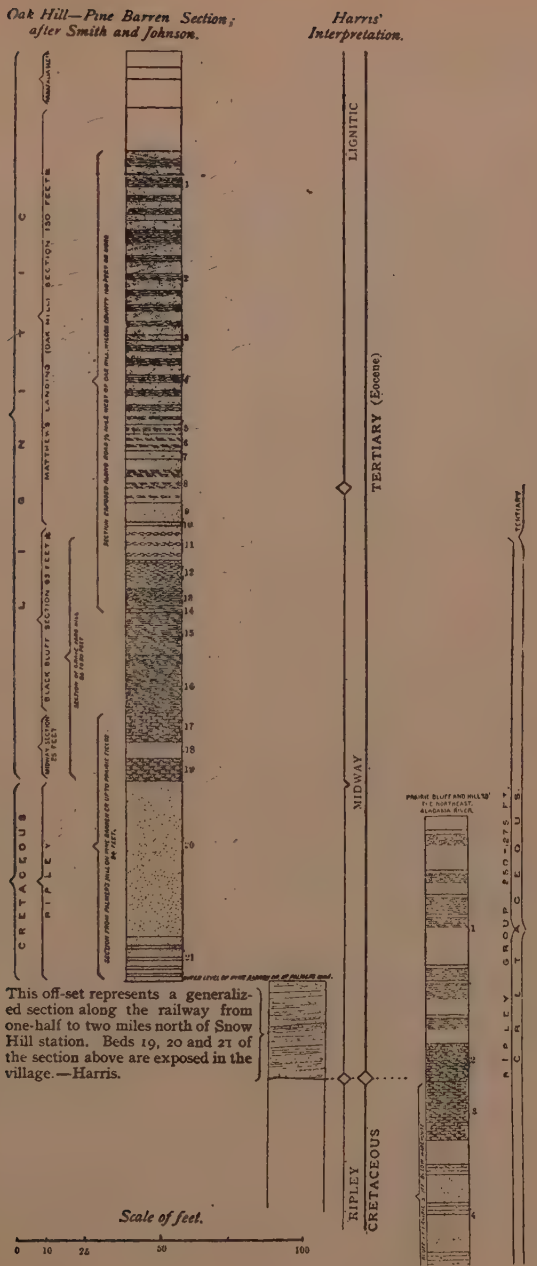
Oak Hill—Pine Barren Section; after Smith and Johnson.
Harris' Interpretation.
CRETACEOUS
EOCENE
RIPLEY
MATTHEWS LANDING (OAK HILL) SECTION 130 FEET±
BLACK BLUFF SECTION 93 FEET±
LIGNITIC
TERTIARY (Eocene)
MIDWAY
RIPLEY
CRETACEOUS
PRAIRIE BLUFF AND HILL'S PIT NORTHEAST, ALABAMA RIVER.
RIPLEY GROUP 250-275 FT.
CRETACEOUS
TERTIARY
This off-set represents a generalized section along the railway from one-half to two miles north of Snow Hill station. Beds 19, 20 and 21 of the section above are exposed in the village.—Harris.
Scale of feet.
0 10 25 50 100

FIG. 4.

above the Cretaceous–Eocene contact more casts may be seen in a matrix very much like that indicated above. The following species are fairly abundant: *Enclimatoceras ulrichi*, *Calyptrophorus velatus* var., *Turritella humerosa*, *T. mortoni*, *Meretrix* probably *ripleyana* and *Venericardia alticostata*.

These exposures to the north of Snow Hill are indicated on p. 31 by bed 21 and the off-set as explained in the section.

Three and one-half miles northeast of Snow Hill and about one mile east-northeast of the last mentioned cut on the railroad north of the station, the Cretaceous-Eocene contact is beautifully exposed in the highway as shown in Plate II. The ledge that shows in the midst of the scenery and causes a sharp descent in the road is caused by the incursion of the Eocene sea. Hence in the greater part of this layer, rolled fragments of *Exogyra*, *Belemnites*, *Nucula percrassa* and many silicious pebbles abound, while at its upper surface and above, *Cucullæa saffordi*, *Enclimatoceras ulrichi*, *Venericardia alticostata* var. and other Midway species occur.

One of the most interesting localities in this region is that designated as Palmer's mill (see frontispiece of this work) in Bull. 43, U. S. Geol. Surv., pp. 67, 73. It is on the Camden road about 5 miles west of Snow Hill. Smith says (p. 67) that in this vicinity "we have the lowermost of the Tertiary beds in direct contact with the uppermost of the Cretaceous. At this place the beds of the two formations appear to be strictly conformable with each other. Here, also, the lower Tertiary beds have a very striking resemblance in lithological characters to some of the Cretaceous; but the fossils, as Mr. Johnson has shown, leave no room for doubt as to the age of the beds."

By turning to p. 73 *op. cit.* or to p. 31 of the present work it will be seen that the strata shown in our frontispiece (Pl. I) are regarded by Smith and Johnson as Cretaceous. By diligent hammering for half a day the writer was able to collect from these beds, *Enclimatoceras ulrichi*, *Venericardia planicosta* (typical), *Calyptrophorus velatus*, *Keilostoma mediavia*, *Meretrix*, *Turritella mortoni*, *Voluta lyroidea*, *Cucullæa saffordi*, *Modiola saffordi* and many fragments, none of which showed a trace of Cretaceous characters. These beds are numbered 21 in the section given on p. 31, and as has been remarked before, they occur in the railroad cut just to the north of the Snow Hill. We therefore conclude that they are at the base some 40 feet above the Cretaceous–Eocene contact. We find no well preserved fossils in bed 20, p. 31, but we have no doubt that had they been obtained they would be Eocene and not Cretaceous, Johnson's statement to the contrary notwithstanding; for they range from 50 to 100 feet above

PLATE II.— Cretaceous–Eocene Contact, 3½ Mi. N. E. of Snow Hill.

the Cretaceous–Eocene contact. Inasmuch as Smith and Johnson put the contact line about 100 feet up in the Eocene, namely, at the base of bed 19, it is not strange that "the two formations appear to be strictly conformable" and that their lithological resemblances are "striking."

Leaving Palmer's mill and going to the south and southwest a mile or two, one observes that beds 17, 18 and 19, p. 31, are all fossiliferous; bed 19 is the so-called Turritella limestone of this region while 17 has been known as the Nautilus and Enclimatoceras rock. It is however bed 18 from which the greatest variety of fossils are obtained. From this zone we procured at Cole's place 1 mile west of Palmer's mill, *Ostrea crenulimarginata*, *Cucullæa saffordi* var., *Venericardia planicosta* typical and var. *smithii*, *Mesalia pumila*, *Calyptrophorus velatus* and many other imperfect specimens.

The most famous locality however for lower Midway fossils yet discovered is on the plantation of W. W. McConnico about 1½ miles southwest of Palmer's mill. We found this plantation in charge of Mr. Stonewall McConnico who very generously gave us the privilege of selecting such fossils from his cabinet as were of most interest to us and then escorted us to the best collecting grounds on the place. Here in a cornfield we obtained *Venericardia planicosta* typical, and var. *smithii*, *Ostrea crenulimarginata*, *O. pulaskensis*, *Crassatella gabbi*, and *C. ?*, *Cucullæa saffordi*, and *C. ?*. *Pectunculus*, *Plicatula?*, *Cerithium claytonense*, *Keilostoma mediavia*, *Turritella mortoni*, *T. alabamiensis*, *Voluta lyroidea*, *Pseudoliva scalina*, *Strepsidura? mediavia*, *Fissurella mediavia*, *Calyptrophorus velatus* var. *compressus*, *Mesalia pumila*, *Natica* and other doubtful specimens.

By the roadside 1 mile south of Palmer's mill we obtained in a cornfield, *Ostrea crenulimarginata*, *Venericardia* var. *smithii*, *Mesalia pumila*, *Strepsidura? mediavia*, *Cerithium claytonense*.

Allenton and Oak Hill and vicinity.—Immediately after crossing Pine Barren creek on the road from Snow Hill to Allenton one ascends a steep slope caused by the presence of the Turritella limestone and its adjacent beds. Besides *Turritellæ*, mostly of the type styled *alabamiensis*, the different varieties of *Venericardia planicosta* are met, along with *Ostrea crenulimarginata*, *Cucullæa saffordi*, *Meretrix*, *et al.*

At Josh Hunter's, about half way from Snow Hill to Allenton, the "Enclimatoceras" and "Turritella rocks" are well displayed, the latter teeming with its typical genus. It contains moreover, *Ostrea crenulimarginata*, *Venericardia planicosta* and var. *smithii*, *Cucullæa saffordi*, *Meretrix*, *Pectunculus*. *Calyptrophorus velatus* var., *Natica*, *etc.* The Enclimatoceras rock affords besides

its typical species, *Cucullæa saffordi*, *Venericardia*, *Yoldia eborea* and corals.

Half way from Josh Hunter's to Allenton we halted and picked out of the rocks at the roadside, *Pholadomya* sp. and *Cucullæa saffordi*.

On the hill-slope 1 mile north of Allenton we encountered the Graveyard Hill fauna and collected in a cornfield, *Enclimatoceras ulrichi*, *Crassatella sepulcollis*, *Cucullæa macrodonta*, *Venericardia alticostata*, *Nucula mediavia*, *Turritella alabamiensis*, *Pleurotoma adeona*, *Dentalium* and corals.

In the highway near the dwelling place of Mr. W. W. McConnico we observed traces of what seemed to be this same fauna. The specimens however were fragmentary. Mr. McConnico very kindly guided us to the famous Oak Hill outcrops and assisted in making two or three valuable collections. A few minutes' stay at Dale's branch sufficed to gather the following specimens: *Venericardia alticostata* (Matthews' Landing var.), *Yoldia eborea*. *Cucullæa macrodonta*, *Nucula ovula*, *Pecten alabamensis*, *Cardium nicolletti* var., *Astarte aldrichiana*, *Dentalium*, *Cadulus turgidus*, *Fulgur eocense*, *Fusus tortilis*, *F. mohri*, *Pseudoliva vetusta*, *Turritella mortoni* var. *levicunea*, *Turritella alabamiensis*, *Strepsidura heilprini*, *Exilia pergracilis*, *Calyptrophorus velatus* var., *Pleurotoma persa*, *P. adeona*, *Pyropsis perula*, *Volutilithes rugatus*, *V. quercollis*, *Caricella leana*, *Scaphella showalteri*, *Natica alabamiensis*, *Levifusus trabeatus* var., *L.? dalei*.

The best and most convenient collecting ground in this vicinity is at the roadside 1 mile west of Oak Hill P. O. This is bed 9, see p. 31. The matrix consists of a blackish, grayish and greenish sandy clay about 6 feet thick and rests upon a hard ledge of sandstone,—bed 10. This shows practically the same fauna as that enumerated from Dale's branch, though it is somewhat more prolific. One of our most important discoveries here was a specimen of *Enclimatoceras ulrichi*, fragmentary to be sure but showing well the form of the volutious and the septa, and coming from the very upper limit of bed 9. Some of the other forms observed here are as follows: *Pecten alabamensis*, *Verticordia*, *Cucullæa macrodonta*, *Yoldia eborea*, *Leda quercollis*, *Venericardia alticostata* (Matthews' Landing var.), *Cadulus turgidus*, *Cylichna meyeri*, *Scaphander alabamensis*, *Pleurotoma adeona*, *P. persa*, *P. mediavia*, *Pleurotomella whitfieldi*, *Levifusus suteri*, *F. mohri*, *F. quercollis*, *F. tortilis*, *F. meyeri*, *Murex matthewsensis*, *M. morulus*, *Fulguroficus juvenis*, *Pyropsis perula*, *Exilia pergracilis*, *Strepsidura heilprini*, *Turritella alabamiensis*, *Trochus alabamensis*, *Olivella mediavia*, *Volutilithes rugatus*, *V. limopsis*, *Pseudoliva unicarinata*, *P. vetusta* var., *Solarium perscelitium*, *S. alabamense*, *N. reversa*.

One-half mile west of Graveyard Hill (between Oak Hill and Palmer's mill) the following species were collected from beds evidently of the same horizon as those seen 1 mile north of Allenton: *Enclimatoceras ulrichi*, *Ostrea pulaskensis*, *Nucula mediavia*, *Cucullæa macrodonta*, *Venericardia alticostata*, *Yoldia eborea*, *Crassatella sepulcollis*, *Pectunculus*, *Tornatellæa quercollis*, *Pleurotoma adeona*, *Olivella mediavia*, *Turritella alabamiensis*, *Mesalia alabamiensis*, *Pyrula juvenis*, *Pseudoliva scalina*, *Volutilithes rugatus*, *Natica perspecta*, *Calyptrophorus velatus* var.

The "hard ledge" around the upper portion of Graveyard hill contains numerous fragmentary specimens of a *Meretrix*, *Venericardia alticostata*, and a Cephalopod probably *E. ulrichi*.

Troy and vicinity.—Our stay in this region was unfortunately very brief and we were unable to obtain any satisfactory sections, exposures or collections. In the road, however, about 3 miles east-southeast of Troy imperfect specimens were obtained of what appeared to be *Ostrea crenulimarginata* and *Venericardia alticostata* in a red iron clay-stone.

Clayton and vicinity.—There are several important exposures in the vicinity of Clayton, Barbour Co., that furnish a well characterized fauna. On the railroad northeast of here about 1 mile a deep cut is seen exposing blue clays above and ledges of light sandy limestone below with many specimens of *Ostrea crenulimarginata*. One-third mile farther on, another cut is found exposing the following beds:—

a.	Dark clay, unfossiliferous as far as observed but containing perhaps some tripoli. Seen in the upper part of cut,	20 feet.
b.	Lignitic clay; dark,	3 feet.
c.	Light yellowish, impure, arenaceous limestone, with innumerable casts and impressions of *Turritellæ* and other forms. According to Dr. Gill a specimen of this contains over 45 per cent. of quartz sand, with a little mica and limonite,	4-8 feet.
d.	Yellow sand. This bed extends from the level of the R. R. track up to the hard limestone ledge (*c*). Barren,	8 feet.
e.	Lignitic clay, more or less micaceous and pebbly, separated from the bed below (*f*) by a line of nonconformability. This is seen only at the east end of the cut,	2 feet.
f.	Blue micaceous, clayey sand. Seen below the R. R. track near the east end of the cut. Nonfos-	

siliferous, - - - - - - 10 feet.

g. Bluish and mottled clay, with hard layers of sand. Nonfossiliferous, - - - - - 10 feet.

h. Bluish clayey sand mottled with yellow and red, very micaceous, and as far as observed, nonfossiliferous. This and *g* are seen in a ravine just east of the cut, - - - - - 30 feet.

The limestone of bed *c* is by no means persistent; towards the eastern end of the bluff it passes into yellow sand and all trace of fossil remains are effaced.

By diligent hammering in these calcareous beds we were able to obtain a number of very nice molluscan impressions, and upon returning to the University, by means of gutta-percha moulds the exact form, size and surface markings of many new as well as old species were ascertained. Perhaps the best find at this locality was casts belonging to *Perna*, a new genus in our Eocene deposits, though not rare in the basal Eocene of Europe. The following are some of the more important species of this locality: *Ostrea crenulimarginata*, *Perna cornelliana*, *Crassatella* sp.?, *Venericardia planicosta* and var., *Lucina claytonia*, *Voluta florencis*, *Calyptrophorus velatus* var., *Pseudoliva scalina*, *Turritella humerosa*, *Turritella* sp., *Cerithium mediaviæ*, *C. globoleve*, *Mesalia watsonensis*, *Keilostoma mediavia*, *Natica* near *onusta*.

In the little ravine just beyond this cut we observed many large fragments of boulders of a peculiar red, clay ironstone containing some sand and a great number of broken quartz crystals. Impressions of fossils are quite common in these boulders. We noted particularly *Turritella humerosa*, *Mesalia watsonensis*, *Venericardia* var. *smithii*, *Ostrea*, *Tellina*, *et al.* They show that although the rocks are not in place they represent a horizon practically that of the limestone described above.

Through the kindness of Dr. Smart of Clayton, Mr. Hubbard was enabled to visit by carriage several important localities more or less distant from the village. From Lee's, near Harrison's mill, 3 miles southwest of Clayton, a large and beautiful series of *Ostrea crenulimarginata* was obtained.

Another locality, 1 mile south of Clayton, near the railroad on Dr. Smart's land furnished *O. crenulimarginata* (fine), *Venericardia planicosta*, *Calyptrophorus velatus*, *Trochita*, *Cardium*, *etc;* the oyster however is the characteristic or predominant species.

Georgia.

Ft. Gaines and vicinity.—The lowest Midway beds seen on the Chattahoochee, lying but a few feet above well defined Cretaceous

deposits, consist of light gray or yellowish impure limestone. This is frequently eroded in a peculiar rough and irregular manner. Silicious pebbles and flakes of mica are common ingredients of the limestone. Fossils are of frequent occurrence in this formation, but here as at Clayton, they consist only of impressions, moulds and casts. They are remarkable for their resemblance to or rather identity with those of the basal limestone east of Middleton, Tenn., (p. 21) referred to as the Turritella rock of northeast Mississippi. Among other forms may be mentioned *Venericardia planicosta*, *V. alticostata*, *Corbula subcompressa*, *Cucullæa* probably *saffordi*, *O. crenulimarginata* (young), *Voluta florencis*, *Strepsidura mediavia*, *Mazzalina impressa* var. *orientalis*, *Turritella tennesseensis*, *T. pumila*, *Calyptrophorus velatus* var.

A little higher up, *i. e.*, downstream, other important species are seen, such as *Voluta lyroidea*, *Meretrix ripleyana*, *Leda saffordana*, *Martesia dalliana*, *Ostrea crenulimarginata* and *O. pulaskensis*.

A bluish, more or less indurated, micaceous, sandy layer outcropping not far above the mouth of Sandy creek furnishes nearly all the species just mentioned as well as *Turritella humerosa* and extremely large specimens of *T. mortoni*.

By far the most interesting Midway locality seen about Ft. Gaines is at the landing. The Midway beds are confined to a few feet of whitish crumbling limestone at the base of the bluff and are overlayed unconformably by Lignitic dark clays. As in nearly all Midway limestone deposits, the shelly matter of the specimens inclosed is entirely removed, and hence one is left to work out the details of the various specific forms by means of gutta-percha moulds. The number of new species is noteworthy; the number of old ones is scarcely sufficient to permit of accurately correlating this bed with anything heretofore described; but partially on faunal and partially on stratigraphic grounds, we have referred it to the upper Midway.

Among the many specimens obtained here the following are the most readily obtained and best preserved: *Astarte subpontis*, *Gastrochæna gainesensis*, *G. cimitariopsis*, *Lithodomus gainesensis*, *Modiola subpontis*, *Ostrea crenulimarginata*, *Chama gainesensis*, *Venericardia* sp., *Arca* sp., *Mitra subpontis*, *Volutilithes* (of Midway rough aspect) sp.?, *Turritella mortoni* var. *levicunea*, *Fusus tortilis*, *Natica mediavia*, *Cerithium gainesensis*. Moreover, a large *Cerithium* fragment showing two internal lirations on the base of the penultimate whorl and some indications of sculpturing, suggests relationship with *C. claytonense*. Casts of *Siliquaria*, *Arca*, *Cypræa*, *Pectunculus* and crab remains were also found here.

ADDITIONAL REMARKS AND DEDUCTIONS.

Nonconformability.

The marked paleontological break between the Cretaceous and basal Eocene as represented in the Mississippi basin, has, we believe, strongly impressed itself upon all our Neozoic paleontologists. That this break should be so complete while no authentical accounts of stratigraphic nonconformity were recorded, seemed indeed anomalous. This deficient record is doubtless chiefly due to three causes: 1st, lack of paleontological knowledge on the part of field geologists, causing them to be unable to locate within a fair approximation of accuracy the dividing line between different formations of similar lithological characters; 2d, paucity of contact exposures; 3d, limited extent of such exposures.

Concerning the particular contact line in question only a few notes will be given, all taken from the writer's personal observation.

Texas.—On the Brazos river there is a bed (see p. 14) one foot thick of doubtful age that divides the Midway from the Cretaceous. The exposure is too limited to determine definitely whether there is discordance or not in the stratification of the respective formations.

Arkansas.—A few years ago the writer* called attention to the fact that in this State the Cretaceous system is overlayed by Midway Eocene deposits to the northeast of Rockport while to the southwest the Cretaceous comes to the surface in a large ▷-shaped expanse. This shows, however construed or explained, that the two systems are nonconformable to each other.

Tennessee.—Unfortunately we did not find any actual Cretaceous–Eocene contacts in this State, but so far as can be judged from Dr. Safford's specimens and notes the stratigraphy along this line is precisely the same as in Mississippi.

Mississippi.—At Chalybeate the spring below the Academy issues from beneath an Eocene limestone layer resting directly upon typical upper Cretaceous marl (see p. 22). Here the foliage is so dense that it was not possible to say whether there was stratigraphic nonconformity or not though the break lithologically and paleontologically was complete.

In a ravine on Mr. Bobo's land, 1½ miles N. N. E. of the spring, the basal bed of Eocene limestone was cemented to an underlying limestone of the same physical aspect bearing *Exogyræ* and *Baculites*. The contact line was marked by a row of large quartz pebbles.

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* Ann'l Rep't Geol. Surv. Ark., 1892, vol. ii; publ. 1894, p. 185.

Near the forks of the road ½ mile south of Ripley, near a spring the following section was obtained:—

a. Red sand.
b. Limestone, - - - - - - 5 feet.
c. Green sand, pebbles, sharks' teeth, - - 1 foot.
d. Blue and yellow clay with fine fragments of *T. mortoni* (young), *C. planicosta*, *etc.*, - - 2 feet.
e. Blue clay with fragments of *Scaphites*, - - 1 foot.

No distinct break was here seen.

Alabama.—In the vicinity of Prairie Bluff the uppermost bed of undisturbed Cretaceous material is generally a bed of hard bluish micaceous clay averaging perhaps 7 feet thick. The upper surface of this bed is wonderfully irregular and has plainly been subjected to strong eroding currents. Above, comes a layer of coarse granular sandstone with pebbles, sharks' teeth, fragments of *Baculites*, *Exogyræ*, *etc.* This bed grades upwards (8-12 feet) into a bluish clay limestone with *Cucullæa*, *Ostrea pulaskensis*, *Enclimatoceras* and several other small stunted Eocene species. These various beds may be seen at the best advantage on Shell creek 1½ miles S. W. of Prairie Bluff (see p. 28), or in the fields to the right of the road as one passes from the Bluff northward from ½ to 2 miles. Immediately at the Bluff the contact line is a few feet below the level of the cotton storage shed.

Since in Smith and Johnson's sections of this bluff they put the Cretaceous–Eocene line far up in the Eocene, the fact that no nonconformity was observed and recorded is readily explainable. In the same way the lack of nonconformity in the "Pine Barren" section has already been accounted for (see p. 33).

By going northward from Snow Hill along the R. R. track one can easily determine the Cretaceous–Eocene contact line with a fair degree of accuracy, say within five feet, but at the time of our visit to that vicinity the exact line and hence the question of nonconformability could not be satisfactorily determined. By going out the highway from Snow Hill, say about 3½ miles, towards Carlowville the contact line is very evident (see pl. II). The lithological as well as the faunal break is complete. The amount of rolled and polished stones and fragments of Cretaceous shells to be found along this line is sufficient evidence of a most complete stratigraphic break.

Georgia.—Here too the lithological and paleontological break is complete. The exposures were not sufficiently extensive along the contact line to enable us to prove discordance of stratification though we doubt not that the same exists.

With only the above facts in mind we are inclined to think that

there was a considerable time interval between the close of Cretaceous deposition and the beginning of Eocene deposition in the Mississippi basin, and that wherever good contact exposures are found, there may be found on careful study, ample evidence of nonconformability.

Correlations made.

The following tables show in a general way the writer's ideas regarding the probable stratigraphic relationship of the various Midway beds heretofore described. Particular attention should be given to the fact that it is the medial portion of the stage only, that has generally been referred to by Alabama geologists as Midway. The lower beds were usually referred to the Cretaceous. Langdon however met the latter on the Chattahoochee river and correctly referred them to the Midway Eocene, though unfortunately he supposed them to be the outgrowth of the "Turritella rock" of central Alabama.

Again, the "Turritella rock" of Mississippi and Alabama are probably 100 feet apart stratigraphically and hence when beds are so designated, it should be stated what locality is referred to; better still, such names should be abandoned. So far as now appears there is a general similarity between the fossils of this stage and those of the basal Eocene of Europe, yet specific identities are rare. There is however a much closer affinity between our fauna and that of the so-called Cretaceous (really Eocene) of Maria Farinha, eastern Brazil.* No one, at all familiar with our Midway fauna can fail to see the close affinities or perhaps identity with our species of *Harpa* [*Pseudoliva*] *dechordata* White, *Calyptrophorus chelonitis* White, *Fasciolaria?* [*Mazzalina*] *acutispira* White, *Turritella sylviana* Hartt, *Nautilus* [*Enclimatoceras?*] *sowerbyanus* White *non* d'Orb., *Gryphæa trachyoptera* White, *Cucullæa hartii* Rathbun, *Cardita morganiana* Rathbun, *C. wilmothii* Rathbun, *et al.*

Dr. White seems to have followed the generally accepted views of the field workers in Brazil and called the fossiliferous beds of various horizons Cretaceous. Long ago the writer suggested to Mr. Stanton of the U. S. Geological Survey that some of the "Cretaceous" material from this river Maria Farinha was to all appearance Midway Eocene. He agreed that it had no traces of Cretaceous features.

*Contr. Pal. Brazil, C. A. White, 1888, vol. vii, *Archivos do Museu Nacional do Rio de Janeiro.*

CORRELATION TABLE, I.

	Texas.					Arkansas.
	Rio Grande.	*Colorado River.*	*Brazos River.*	*Limestone Co.*	*Kaufman Co.*	*Little Rock.*
UPPER.			Bluff near Smiley's. *p. 14.* Black Bluff.	Sands South of Tehuacana.	Wills Point Clays and Sand. *p. 15.*	Tubulostium bed.
MEDIAL.	"Cardita" Bluff. *p. 13.*	Limestone near Webberville. *p. 14.*	½ mile below Cret.–Eoc. Contact. *p. 14.*	Tehuacana and Horn Hill Limestones. *p. 15.*	Rocky Cedar Creek Limestone. *p. 16.*	Enclimatoceras and Turritella Limestones. *p. 17.*
LOWER.			At Eocene–Cretaceous Contact. *p. 14.*	Boulder Clay North of Tehuacana.	Clays West of Rocky Cedar Creek.	

CORRELATION TABLE, II.

Tennessee.		Miss.	Alabama.				Ga.
Crainesville.	*Middleton.*	*Ripley.*	*Tombigbee River*	*Alaba. River.*	*Oak Hill etc.*	*Clayton.*	*Ft. Gaines*
	Porter's Creek.	Black Clay 3 miles N. W. of Ripley	Naheola Marls. *p. 25.* Black Bluff Upper.	Matthews' Landing Clays. *p. 29.*	Marl 1 mile West of Oak Hill P. O. Graveyard Hill. *p. 34.*		?Limestone of Ft. Gaines
Outcrops at Hannah's and Huddleston's. *p. 18.*	Middleton Calcareous Green-specked Clays. *p. 21.*	Venericardia Bed 1½ miles N. W. of Ripley *p. 23.* Blue Mt.	Black Bluff Middle Clays. *p. 25.*	Midway Limestones. *p. 29.*	Enclimatoceras and Tur'tella Limestone S. of Palmer's Mill. *p. 33.*	Oyster Beds 1 mile S. and 3 miles S.W. of Clayton.	Beds near the mouth of Sandy Creek.
Base of Bed *f* at Hannah's. *p. 18.*	Clay and Limestone 2 miles E. of Middleton. *p. 21.*	Ripley Clays and Limestone. *p. 23.*	Black Bluff Lowest Clays.	Beds *b, c, d.* *pp.* *28-29.*	Beds 20, 21 and off-set. *p. 31.*	Limestone 1⅓ miles N. E. of Clayton.	Basal Limestone Beds.

Mr. Orville A. Derby, a former Cornellian, now State Geologist of Sao Paulo, in reply to recent inquiries, says:—

"Your letter of Jan. 28th [1896] has interested me very much.

"Some years ago while I was still in the Museum, a German paleontologist (whose name I do not now remember with certainty but I think it was Koken) wrote to the Director in the same sense. I replied to the letter calling attention to the more pronounced Cretaceous character of the Sergipe fauna and suggesting that he discuss this question for which I offered to furnish the material, but I heard nothing further in the matter.

"I believe also that some of the German notices of Dr. White's work referred to the Tertiary aspect of many of the fossils, but as far as I know no proper discussion has been given to the subject.

"The age determination of these faunas on geological grounds is weak and would not stand against decided paleontological evidence. The assumption that the different basins are substantially of the same age is unproven. We had fallen into the habit of calling all the slightly disturbed fossiliferous beds Cretaceous, and the undisturbed nonfossiliferous ones Tertiary, but without definite proof.

"I had expected that the study of the fossils would show a closer relationship between the faunas than it did. That of Maria Farinha can only be connected with that of Sergipe, which as I understand is the most typical Cretaceous, through that of Para. And if this argument fails its reference to the Cretaceous falls to ground."

Variation of faunas.

It seems indeed remarkable that certain very characteristic species of the Midway fauna, throughout Texas, Alabama, Tennessee, Mississippi and western Alabama, should die out or be replaced by others between central Alabama and Chattahoochee river. There are, to be sure, a sufficient number of connecting links in the lower and middle portions of the stage to serve well for correlation purposes. In fact the fauna from the Muddy Creek limestone, Tenn., and that of the basal Eocene beds on the Chattahoochee are remarkably alike. There are, too, the characteristic central Midway species of *Ostræ*, *Turritellæ*, *Venericardiæ*, *etc.*, on the Chattahoochee. But the paucity of *Volutilithes*, *Crassatella*, *Cucullæa*, *Pseudoliva*, *et al.*, is noticeable. The upper Midway bed at the base of the bluff at Ft. Gaines bears a fauna almost wholly new. Its correlation with upper Midway faunas farther west on the Alabama river and near Oak Hill is not proven. We are led to believe that it differs so widely from the last mentioned faunas because of differences in environment;

instead of living on a sea bottom of black muddy ooze, it flourished in a clear coralline sea.

The absence of *Enclimatoceras* in the Chattahoochee section does not mean the absence there of any one particular bed; we have already shown how great is the vertical range of this genus. Much less does its absence mean that all the beds that do not contain it are the out-growth of the so-called "Turritella rock" of central Alabama.

PART II. PALEONTOLOGY.

DESCRIPTION OF THE MOLLUSCAN REMAINS OF THE MIDWAY STAGE.

Pelecypoda.

OSTREA.

Ostrea crenulimarginata, { Pl. 1, fig. 1, a, Pl. 2, fig. 1, a, Pl. 3, fig. 1.

Syn. *O. crenulimarginata* Gabb, Jr. Phila. Ac. Nat. Sci., 2d ser., vol. 4, 1860, p. 398, pl. 68, figs. 40, 41.
O. denticulifera Gabb, *non* Con., *Ibid.*, p. 398.
O. denticulifera Safford, *non* Con., Geol. of Tenn., 1869, p. 419.
O. præ-compressirostra Harris, Ark. Geol. Surv., vol. 2, 1892, publ. in June, 1894, p. 39.
O. compressirostra Langdon, *non* Say., Geol. Surv. Ala., 1894, p. 413.
O. tumidula Aldrich, Geol. Surv. Ala., Aug., 1894, p. 242, pl. 14, figs. 1 & 2, pl. xv, figs. 1 & 2.

Gabb's original description.—"Subtriangular, sometimes elongated, oval; attached; portion of the outside of the shell not attached is very squamose; hinge about an equilateral triangle, central groove of the hinge deep; internal margin strongly crenate, muscular impression large; upper valve?.

"*Dimensions.*—Length 2.2 in., greatest width about 2 in.

"*Locality.*—Found in a marl bank, two miles east of Middleton, Tenn. Rather common and associated with *O. denticufera* Con."

The type specimens of this species were very kindly lent me by Dr. Safford. The figured specimen, fig. 40, *op cit.*, was attached during growth to a nearly flat fragment of wood and hence does not show well the radiating plications, yet they are indicated in one place. One of the specimens grew on a *Venericardia planicosta*, and shows ribbing. Gabb for some unknown reason selected out the most of the left valves in Safford's collection and named them *crenulimarginata*, while the right valves he styles *denticulifera*; all these I have before me. They are small and immature. The characters of the species are well shown on pl. 1, fig. 1, a, and pl. 2, fig. 1, a, after Aldrich. The lesser valves when young present a peculiar pyri-circular outline and are smooth, thin and convex. Such specimens are common 1 mile north of Midway.

Fig. 40 of Gabb's work is, according to Dr. Safford's notes, from a "bank near, or on the old stage road 2 miles south of Middleton." Others are from the R. R. cut 2 miles east of Middleton, and still others from the limestone on Muddy creek east of Middleton.

Localities.—TEXAS: Horn Hill and Tehuacana, Limestone Co.; Brazos river, 3 miles above mouth of Pond creek.
ARKANSAS: 1⅝ mi. N. of Bradford, St. L., I. M. & S. R. R.; Johnson's well, Capitol Hill, Little Rock; Sect. 15, 1 S., 14 W.; N. W. of N. E. ¼, Sect. 8, 1 S., 13 W.; Sect. 18, 2 S., 15 W.; Cabot, Lonoke Co.
TENNESSEE: East and south of Middleton 2 miles; McDonald's mill 4 miles S. W. of Middlton.
ALABAMA: 1 mi. N. of Midway; 1 mi. W., 1½ mi. S. W. and 1 mi. S. of Palmer's mill; R. R. cut at Snow Hill; R. R. cut ½ mi., and 2 mi. N. of Snow Hill; 3 mi. N. E. of Snow Hill; Pine Barren creek 2 mi. S. of Snow Hill; Graveyard Hill, hard ledge; Josh Hunter's; ? 3 mi. E. S. E. of Troy; Dr. Smart's, 1 mi. S. or S. W. of Clayton, near R. R.; Lee's, near Harrison's mill, 3 mi. S. W. of Clayton; 1 & 1⅓ mi. N. E. of Clayton.
GEORGIA: Chattahoochee river, near mouth of Sandy creek, and ? at base of bluff at Ft. Gaines.

Type.—Collection of Jas. M. Safford, Vanderbilt Univ., Nashville, Tenn.

Ostrea pulaskensis, Pl. 1, figs. 2, a, b, c; 3, a.

Syn. *Gryphæa vomer* Saff., Geol. of Tenn., 1869, p. 419.
"*Gryphæa pitcheri* Mort.?" White, Proc. U. S. Nat. Mus., vol. iv, 1881, p. 137.
O. pulaskensis Har., Ark. Geol. Surv., vol. ii, 1892, p. 40, pl. 1, figs. 3, a, b, c, d.
Gryphæa vomer Langdon, Geol. Sur. Ala., 1894, p. 416.

Harris' original description.—"Outline of the larger valve rightangle-triangular; a carination from the umbo to the posterior basal margin forming the hypothenuse, the basal margin the base, and the shorter margin from umbo to base the perpendicular with proportional lengths of 8, 7 and 5 respectively; beak generally very incurving; carination often very pronounced; between it and the margin of the valve are one or two more or less distinct sulci; surface comparatively smooth, though possessing a few slight

concentric undulations which, curving upwards in the middle of the valve, form a very shallow sulcus extending from beak to base; muscular impression not distinctly marked; lesser valve thin, flat, circular; marked exteriorly by lines of growth; smooth within, with an oval muscular impression which is submarginally located.

"This description, and the figures referred to, show the most *Gryphæa*-like phase of this species. Other forms are less distinctly sulcate and carinate."

Peculiar specimens, presumably of this species, occur 1 mile north of Midway. They seem to have adhered most readily by the posterior portion of the valve so that they became distorted. In some instances the left valve appears like a half valve, *i. e.*, the valve is split from the apex to the base and glued on some surface by the straight edge; or the basal anterior margin is greatly produced as in *Gryphæa trachyoptera* White.

Localities.—TEXAS: Brazos river, Falls Co., about 1 mi. above the Milam Co. line or ½ mile below the Cretaceous–Tertiary contact on this river.

ARKANSAS: N. W., S. E. ¼, Sect. 8, 1 S, 13 W.; Sect. 15, 1 S., 14 W.; Sect. 2, 3 S., 16 W.; Sect. 36, 2 S., 16 W.

TENNESSEE: Hannah's, 1¾ mi. N. of Crainesville, bed *b*; Huddleston's; McDonald's mill, 4 mi. S. W. of Middleton.

MISSISSIPPI: ½ mi. S. of Ripley; 2 mi. E. of Ripley (?).

ALABAMA: Road ¾ mi. W. of Prairie Bluff; 1 mi. N. of P. B.; 1 mi. N. of Matthews' Landing (varietal form); 1½ mi. S. W. of Palmer's mill (var.); ½ mi. W. of Graveyard hill.

GEORGIA: Chattahoochee river, near mouth of Sandy creek.

Types.—U. S. National Museum.

PLICATULA.

Plicatula?, Pl. 2, fig. 2, a.

This strange form has been figured simply to call attention to its existence so that others may seek more perfect specimens and determine its true place generically and specifically.

From ½ mile E. of S. McConnico's, near Palmer's mill, from bed 18 of section on p. 31.

PECTEN.

Pecten alabamensis, Pl. 2, fig. 3.

Syn. *P.* (*Pleuronectia*) *alabamensis* Ald., Geol. Surv. Ala., Bull. No. 1, p. 40, pl. 4, fig. 8.
P. (*Amussium*) *alabamensis* De Greg., Mon. Faun. Eoc. Ala., 1890, p. 183, pl. 21, fig. 26.
P. alabamensis Har., Geol. Surv. Ark., vol. ii of Rep't for 1892, p. 41.

Aldrich's original description.—"Shell small, suborbicular; upper valve covered with equidistant concentric lines which run over upon the anterior ear; a few raised radial lines upon the center and anterior side; ears small; right valve nearly smooth; within both valves eight raised prominent rounded ribs, becoming obsolete as they approach the beak.

"*Locality.*—Matthews' Landing, Ala.

"Seems to unite *Pleuronectia* and *Pecten*. One specimen shows concentric striæ and ribs in the younger part of shell, these becoming obsolete toward the ventral margin."

Localities.—ARKANSAS: Marshall's well, Little Rock. Tubulostium bed.
ALABAMA: Naheola; Matthews' Landing; Dale's Branch.

Type.—Collection of T. H. Aldrich.

AVICULA.

Avicula sp., Pl. 2, figs. 4, a.

We have obtained from the Midway stage but a few imperfect casts of this genus, all from near the mouth of Sandy creek on the Georgia side of the Chattahooche river. They represent but one species, and are too imperfect to merit specific description.

Specimens figured.—Paleontological Museum, Cornell Univ.

PERNA.

Perna cornelliana n. sp., Pl. 3, figs. 2, 3.

Specific characterization.—General form as indicated by fig. 2; apical cartilage pits short and much wider than the interspaces, the anterior two bounded below by an oblique tooth-like elevation; posteriorly, pits and interspaces becoming of more nearly the same width, while the pits are somewhat contracted above; muscular

impressions numerous about the anterior apical portion of the body cavity, shown in the figure as small elevations about the beak of this internal cast; shell rather thin.

This species resembles *P. bazini* Desh. in general, but has different umbonal and ligamental characters and is more oblique. Deshayes species is from the *Sables inférieurs* of the Paris basin.

We have felt much hesitation in naming specifically specimens so imperfectly preserved. But the peculiar hinge characters and the interest attached to the discovery of this genus in our Eocene deposits render it doubly advisable to have a name whereby the species may be conveniently referred to.

Locality.—Railroad cut, 1⅓ miles N. E. of Clayton, Barbour Co., Ala.

Type.—Paleontological Museum, Cornell Univ.

MODIOLA.

Modiola subpontis n. sp., Pl. 3, figs. 6, a.

Specific characterization.—General form as shown by the figure —twice natural size; very gibbous especially about the umbones which are incurving and resemble those of *Lithodomus gainesensis;* surface marked by strong, bifurcating, radiating lines like those of many members of this genus; near the umbones the lines are less distinct. This shell is found in the burrows or within the shells of *Gastrochæna* or *Lithodomus.* The one figured was broken out of an *L. gainesensis* a part of which is shown in the figure. A portion of the exterior of this individual is shown in fig. 6, a.

Locality.—Uppermost layer of the Midway limestone as exposed at Ft. Gaines, Ga. Rare.

Type.—Paleontological Museum, Cornell Univ.

Modiola saffordi, Pl. 3, fig. 4, 5.

Syn. *M. saffordi* Gabb, Jr. Ac. Nat. Sci., vol. iv, 1860, p. 395, pl. 68, fig. 30.
M. saffordi Saff., Geol. Tenn., 1869, p. 419.

Gabb's original description.—"Gibbous, widened posteriorly; beaks small, anterior; umbones very large; umbonal ridge prominent, rounded, with a rounded furrow anterior to it; cardinal margin nearly straight, posterior margin rounded, basal sinuous; surface marked by regular radiating ribs, except a small space between the umbonal ridge and the beak, leaving a little more than one-third of the basal portion plain, or only marked

by lines of growth.

"*Dimensions.*—Length, .3 in., width, .6 in., greatest height of valve, .2 in.

"*Locality.*—From the marls and alternating limestone of the Ripley Group, Hardeman Co., Tenn."

Fig. 4 is from bed *b* at Hannah's, Hardeman Co., Tenn. Fig. 5 from Texas, is probably of the same species.

Type.—Not found in the material sent by Dr. Safford. Lost?

LITHODOMUS.

Lithodomus gainesensis n. sp., Pl. 3, figs. 7, a.

Specific characterization.—General form as shown by the figures; cylindrical; half the size indicated; umbones anterior, very incurving; no teeth; shell thin, marked exteriorly generally by a few concentric low undulations; one specimen shows three or four radiating lines posteriorly; valves apparently entirely closed; no radiating lines seen near the anterior. One specimen was collected which is nearly twice the ordinary size.

Locality.—Uppermost Midway Eocene limestone exposed at Ft. Gaines, Ga. Very common.

Type.—Paleontological Museum, Cornell Univ.

ARCA.

Arca sp., Pl. 3, figs. 8, 9, a.

This little *Arca* is quite common in the uppermost layer of the Midway limestone at Ft. Gaines. It is characterized by rather strong concentric folds, which become tuberculate or spinose where crossed by radii; the latter comparatively few in number and strong on the anterior slope; anterior half of the face of the valve with fine radii; posterior coarser and becoming very coarse and spinose at the umbonal angle; posterior to this, both concentric and radiating sculpturing, well defined. Specimens of somewhat larger size are found near the base of the Midway on the Chattahoochee not far above the mouth of Sandy creek. Another large specimen presumably of this species, was found in a cotton field 1 mile north of Midway. It has a decidedly *Arca mississippiensis*-like aspect. It is about ¾ of an inch in length. It seems unwise to name this species until its relations with the other Eocene *Arcæ* can be more fully investigated. It has the aspect of "*Navicula aspera*" Con. or of *Arca lyelli* of England.

CUCULLÆA.

Cucullæa macrodonta, Pl. 3, figs. 10, a.

Syn. *C. macrodonta* Whitf., Am. Jr. Conch., vol. i, 1865, p. 267, pl. 27, fig. 17.

Whitfield's original description.—"Shell of medium size, subrhomboidal in outline, broad heart-shaped in profile; hinge line nearly as long as the greatest length of the shell; hinge area broad, corrugated; valves deep; beaks distant, slightly incurved; surface marked by from forty-five to fifty low, radiating ribs, which are finely corrugated by concentric lines; ribs indistinct on the posterior part; a rather deep, narrow sulcus extends from the beak to the posterior basal angle, leaving a prominent umbonal ridge; hinge line with sixteen teeth, the right valve having four at each extremity parallel to it; muscular scars sub-quadrangular, the posterior much the largest; muscular ridges faint or obsolete; pallial line crenulate; inner margin of shell smooth.

"This species is remarkable for the very transverse lateral teeth, a feature not often noticed in fossil species of the genus.

"*Locality.*—Nine miles below Prairie Bluff, Alabama."

When the two valves of this species are found together, the right is somewhat smaller, and shuts into the left along the basal margin. Whitfield apparently had but one valve (right), and hence his description is more applicable to the following species than it is to this. The surface markings of the two valves are shown in our figures; that of the right is constant while that of the left is subject to extreme variations. Some specimens, especially those found along the Tombigbee river, show but three or four ribs of the stronger series on the left valve; others show less pronounced difference in sculpturing between the two valves.

Localities.—TEXAS: Brazos river, near Falls–Milam Co. line; Webberville, Colorado river.

ALABAMA: Tombigbee river, Black Bluff and below as far as Naheola; ? 1 mi. north of Midway; Matthews' Landing; 1 mi. N. of Allenton; 1 mi. W. of Oak Hill; ½ mi. W. of Graveyard hill.

Type.—Hall's collection.

Cucullæa saffordi, Pl. 3, fig. 11; pl. 4, figs. 1, 2.

Syn. *Arca saffordi* Gabb, Jr. Ac. Nat. Sci. Phila., vol. iv, 1860, p. 397, pl. 68, fig. 38, *non* 37 as in text.

Cucullæa macrodonta Har., Geol. Surv. Ark., vol. ii, 1892, p. 41.

C. transversa Ald., Geol. Surv. Ala., 1894, p. 242.

Gabb's original description.—Gibbous, nearly equilateral; beaks small, overhanging the area; umbones broad; area narrow and transversly striate; anterior margin narrower and straighter than the posterior, which is regularly curved; surface marked by obscure radiating and concentric lines; hinge rather broad, curved; teeth large.

"*Dimensions.*—Length .2 in., width .26 in., height of valve .1 in.

"*Locality.*—Hardeman Co., Tenn. Prof. Safford. Also found in the Ripley group of New Jersey."

We have not had access to Gabb's type of this species and presume it is lost, since Dr. Safford did not send it along with Gabb's other types. However, our collection contains a large number of specimens from a similar horizon and some from approximate localities; hence it seems that since Gabb's figure and description correspond very well to casts of our specimens it is safe to use his term for designating them.

When studying over and reporting upon the Arkansas material from this horizon it was noted that "The original description of *C. macrodonta* is more applicable to this form than to those from the typical locality [Matthews' Landing] inasmuch as the latter possess strong irregular ribbing on the left valve, while in the the right the sculpturing corresponds to Whitfield's description and to that of both valves of the specimens from Arkansas," (l. c., p. 41).

Not knowing then that Gabb had given a specific name to this form the writer classed it in with *C. macrodonta* which, with the vast amount of material before him at present he regards as incorrect. The name *saffordi* is here used tentatively in place of older names, *transversa* or *gigantea*, for it seems as though it differs somewhat from those species especially in surface marking and in form. The right valve when of ordinary outline and when well preserved looks like the corresponding valve of *C. macrodonta*, and if there were no left valves among a given number of specimens, it would be quite impossible to know to which of the two species, *saffordi* or *macrodonta*, to refer them.

The two valves of *saffordi* are similarly marked while those of *macrodonta* vary considerably (see figures).

There is much variation in the forms of the specimens here referred to *saffordi*. The most remarkable of which is that figured on pl. 4, fig. 1, which is from the so-called Turritella limestone at Hamburg (Josh Hunter's, between Oak Hill and Allenton).

From the striking similarity of these two species it is quite evident that *macrodonta* is the direct descendant of *saffordi*.

Localities.—TEXAS: ? 18 mi. S. E. of Eagle Pass; 4 mi. N. E. of Kemp, Kaufman Co.
ARKANSAS: Olsen's switch, Pulaski Co.; Johnson's well, Little Rock.
TENNESSEE: Hannah's, Huddleston's and Middleton, Hardeman Co.
MISSISSIPPI: Reeve's; limestone ½ mi. S. of Ripley; ½ mi. N. of Ripley; 1 mi. E. of Ripley; Blue Mt., Tippah Co.
ALABAMA: Basal Eocene bed about Prairie Bluff; 1 mi. N. of Midway; 3 mi. N. E. of Snow Hill; Palmer s mill; Cole's place; S. McConnico's, 1½ mi. S. W. of Palmer's mill; Josh Hunter's.

PECTUNCULUS.

Pectunculus, Pl. 4, fig. 3.

The *Pectunculi* of the Midway are not generally well preserved, but as far as can be determined at present they all represent one and the same species. Fragments somewhat eroded, though showing occasional surface markings, indicate a closer affinity with *idoneus* than with *stamineus;* the peculiar strong concentric striæ of the latter are wanting while the fine radiating striæ are present. The Midway species is seemingly the same as that found in the Lignitic at Gregg's Ldg., hence we defer a more minute description of it here.

Localities.—TENNESSEE: 5 mi. S. of Crainesville. (Sp. fig'd.)
ALABAMA: 1½ mi. S. W. of Palmer's mill, Wilcox Co.; between Snow Hill and Allenton, at "Hamburg"; ½ mi. W. of Graveyard hill, Wilcox Co.
GEORGIA: Uppermost layer of the Midway at Ft. Gaines.

NUCULA.

Nucula mediavia n. sp., Pl. 4, fig. 4.

Specific characterization.—Size and general form about as figured; surface showing besides lines of growth, many radiating striæ; lunule large, deeply depressed and sometimes traversed by a faint radiating ridge; within, strongly crenulate at margin; posterior as well as anterior row of teeth well developed, each tooth angulate in the middle; angle formed at the junction of the two rows of teeth about 130 degrees.

The sharp posterior, deeply sunken and sharply defined lunule, great angle formed by the junction of the two rows of teeth and coarsely crenulated margin, serve to distinguish the species.

This is doubtless the "*N. magnifica*" Ald., Bull. No. 1, Geol. Surv. Ala., 1886, p. 61.

Localities.—ALABAMA: Black Bluff, Tombigbee river; ½ mi. W. of Graveyard hill; 1 mi. N. of Allenton, Station 264, Prairie Cr., Wilcox Co. (U. S. Nat. Mus. coll).

Type.—Paleontological Museum, Cornell Univ.

Nucula ovula, Pl. 4, fig. 5.

Syn. *N. ovula* Lea, Cont. to Geol., 1833, p. 80, pl. 3, fig. 59.

Lea's original description.—"Shell ovate, oblique, inflated, very inequilateral, transversely striate, longitudinally and very minutely ribbed; substance of the shell thin; lunule large, not deeply impressed; beaks pointed, recurved; anterior series of teeth short—posterior series long; fosset nearly direct; cavity of the shell deep; margin very minutely crenulate; nacre pearly.

"Diam. .3, length .4, breadth .5, of an inch."

This was described from the Claiborne sand.

Locality (Midway stage).—ALABAMA: Dale's Branch, Oak Hill.

Type.—Phila. Ac. Nat. Sci.

LEDA.

Leda milamensis, Pl. 4, fig. 8.

Syn. *L. milamensis* Har., Proc. Ac. Nat. Sci. Phila., 1895, p. 47, pl. 1, fig. 4,

Harris' original description.—"General form as figured; surface covered with fine concentric striæ execpt near the anterior margin where it is smooth and polished; diameter from beak to base great, and the shell here much inflated; posterior remarkably narrow and flattened.

"*Locality.*—Smiley's Bluff, Brazos river, two miles above the mouth of Pond Cr.

"*Geological horizon.*—Midway Eocene.

"*Type specimen.*—Texas State Museum."

The figure herewith given is much more typical of the species than the one given in the Phila. Ac. Proc. The anterior half or two-thirds of the shell is very much inflated and is sometimes

striate, but in the state of casts, the only markings generally observable are the concentric lines on the flattened posterior.

The new localities we have recorded are: Hannah's, bed *f*, 1¾ miles N. of Crainesville, Hardeman Co., Tenn., and Huddleston's, about the same distance W. of Crainesville.

Leda saffordana n. sp., Pl. 4, fig. 9.

Syn. *L. protexta* Gabb, Jr. Ac. Nat. Sci. Phila., vol. iv, p. 397, pl. 68, fig. 36, (*non L. protexta* Gabb, ibid., p. 303, pl. 48, fig. 23. ? *Leda bella* Con., ibid., p. 295).

Specific characterization.—Size and general form as indicated by the figure (some specimens somewhat more elongate); concentric lines rather prominent centrally but becoming obsolete anteriorly and posteriorly; a slight depression passing from umbo to post basal margin; escutcheon bordered by a well defined ridge and traversed medially by a fainter secondary ridge.

Localities.—TENNESSEE: Near the old stage road, about two miles S. of Middleton, Hardeman Co.
ALABAMA: ½ mi. N. of Snow Hill.
GEORGIA: Near base of Eocene on Chattahoochee river.

The specimens described by Gabb were kindly lent the writer by Dr. Safford. They certainly are not the *L. protexta* Gabb, p. 303, as referred to above; hence the need of a new name and *L. saffordana* has accordingly been proposed. The large, imperfect specimen Gabb refers to, p. 397, is quite probably a different species from the smaller forms.

Type.—Collection of Jas. M. Safford, Nashville, Tenn.

Leda elongatoidea var.?, Pl. 4, fig. 10.

A single valve of a marked variety of a species quite common at Wood's Bluff, Ala., was found at Matthews' Landing. Both this and the Wood's Bluff specimens do not agree entirely with Aldrich's description and figure of *L. elongatoidea* (Bull. Am. Pal. No. 2, p. 17), hence we postpone further discussion until we have ampler material and know to a certainty to what species the name *elongatoidea* has been given.

Leda quercollis n. sp., Pl. 4, fig. 11.

Specific characterization.—Size and general form as indicated in the figure; thick; surface covered throughout with rather strong concentric lines; a faint sinus extending from beak to pos-

terior–basal margin; within, of the same dark brown polished appearance that characterizes the interior of *Yoldia eborea;* anterior row of teeth equaling or surpassing in strength and length those of the posterior.

This species is plainly the ancestor of *L. robusta* Ald. from Wood's Bluff. It differs from his species in having much finer striæ which continue over the whole surface of the valve; in *rabusta* the anterior–dorsal region is nude. *L. quercollis* is about two-thirds the dimensions of *L. robusta*, has a much less angular appearance and a fainter radiating posterior sinus.

Localities.—ALABAMA: 1 mi. W. of Oak Hill P. O., Wilcox Co.; Dale's Branch near Oak Hill P. O., Wilcox Co.

Type.—Paleontological Museum, Cornell Univ.

YOLDIA.

Yoldia kindlei n. sp., Pl. 4, fig. 6.

Specific characterization.—Size and general form as indicated by the figure; surface in casts smooth, but in some well preserved fragments indicating more or less regular lines of growth; somewhat inflated.

Named in honor of a most energetic and promising young paleontologist of this University.

Locality.—TENNESSEE: 1¾ mi. N. of Crainesville, at Hannah's, Hardeman Co. Bed *f.*

Type.—Paleontological Museum, Cornell Univ.

Yoldia eborea, Pl. 4, fig. 7.

Syn. *Leda eborea* Con., Jr. Ac. Nat. Sci. Phila., vol. iv, 1860, p. 295, pl. 47, fig. 26.

Conrad's original description.—"Triangular, equilateral, ventricose, smooth, polished; lunules of equal length and defined by carinated lines; anterior lunule widely elliptical; dorsal margin when the valves are together defined by a slight carina; a slight furrow near the posterior dorsal margin and parallel with it; posterior end acutely rounded and submargin slightly contracted; base regularly rounded.

"Length, ⅝ inch."

There is considerable variation in the size as well as the shape of this species. The Tombigbee river specimens are larger and longer than those from the Alabama river exposures; yet they

doubtless all belong to one species. This is one of the typical Midway forms, occurring quite abundantly throughout the same areal extent and horizons with *Enclimatoceras ulrichi*.

Localities.—TEXAS: Brazos river, from Cretaceous–Eocene contact to Falls–Milam Co. line, several localities.
ARKANSAS: Marshall's well, Capitol Hill, Little Rock; Sect. 2, 3 S., 16 W.; Sect. 18, 2 S., 15 W.
TENNESSEE: Hannah's, 1¾ mi. N. E. of Crainesville, Hardeman Co., beds *a* & *f;* Huddleston's, 2 mi. W. of Crainesville.
MISSISSIPPI: Blue Mt., S. of Ripley.
ALABAMA: Black Bluff; Tombigbee river, 4 mi. below Black Bluff; hill just N. of Prairie Bluff; Matthews' Landing; ½ mi. W. of Graveyard hill; 1 mi. W. of Oak Hill; Palmer's mill; Bed *e*, ¾ mi. W. of Prairie Bluff; Dale's branch; "Enclimatoceras limestone" at Hamburg.

VENERICARDIA.

Venericardia alticostata, Pl. 4, fig. 12.

Syn. *V. alticostata* Con., Amer. Jr. Sci., vol. xxiii, 1833, p. 342.
V. perantiqua Con., Amer. Jr. Conch., vol. i, p. 8.
V. perantiqua Whitf., Mon. U. S. G. S., vol. ix, p. 232, pl. 30, figs. 8-10.

Conrad's original description.—"Shell subcordate, convex, with about twenty-two profoundly elevated nodulous ribs, which on the anterior side are laterally carinated. Length, two inches.
"*Locality.*—Claiborne, Ala. *London clay.* Extremely abundant and very variable in outline."

The first forms that presumably merge into this species are very small, about 1 centimeter in length, with 12 ribs, and occur at the very base of the Midway, 3½ mi. N. E. of Snow Hill and in the vicinity of Prairie Bluff. See base of off-set in section (p. 31). Higher up in beds of this off-set a form more nearly typical is encountered. It has from 14 to 18 ribs and is an inch or more in length.

Localities.—TEXAS: 18 mi. S. E. of Eagle Pass.—Dr. White; near Webberville.
ALABAMA: Snow Hill, R. R. cut; 1½ mi. N. of Snow Hill, R. R. cut; 2 mi. N. of Snow Hill, R. R. cut; Palmer's mill.

Closely allied forms occur at the base of the Midway on the

Chattahoochee river, Ga., and in the hard ledge which surrounds Graveyard hill, Wilcox Co., Ala.

In the higher argillaceous deposit of this stage a very sharp (25-30) ribbed variety occurs. See fig. 12 on pl. 4.

Localities.—ALABAMA: Naheola; Matthews' Landing (bed 9); 1 mi. W. of Oak Hill P. O. (bed 9); ½ mi. W. of Graveyard hill (bed 15); 1 mi. N. of Allenton (bed 15).

Venericardia planicosta, Pl. 4, fig. 13.

Syn. *Venericardia* (*planicosta*) Lam., Ann. du Mus., vol. vii, 1806, p. 55; *ibid*, vol. ix, 1807, pl. 31, figs. 10, a, b.
V. planicosta Con., Jr. Ac. Nat. Sci. Phila., vol. vi, 1830, pp. 213, 214 and 215.
Venericardia ascia W. B. & H. D. Rogers, Trans Am. Philos. Soc., 2d ser., vol. v, 1839, p. 374, pl. 29, fig. 2.
Cardita densata Con., Jr. Ac. Nat. Sci. Phila., 2d ser., vol. i, 1848, p. 130, pl. 14, fig. 24.
Cardita planicosta Con., U. S. Mex. B'd'y. Surv., 1857, p. 161, pl. 19, figs. 2, a, b.
Cardita hornii Gabb, Geol. Surv. Cala., Paleont., vol. i, 1864, p. 174, pl. 24, fig. 157.
Venericardia planicosta var. *regia* Con., Am. Jr. Conch., vol. i, 1865, p. 8.
Venericardia mooreana Con., Am. Jr. Conch., vol. iii, 1867, p. 190.
? Venericardia complexicosta Ald. and Mr., Jr. Cin. Soc. Nat. Hist., vol. ix, pt. 2, 1887, p. 45, pl. 2, fig. 21, 21a.

Lamarck's original description.—"*Venericardia* (*planicosta*) obliquè cordata, crassissima; costis planis integris; posticis granulatis."

"Knorrs, foss. part. 2, tab. 25, f. 5.

"*β. Eadem minor, suborbiculata.* Vélin, n°. 52, f. 3.

"L. n. Grignon et ailleurs. C'est une très belle espèce dont on n'a trouvé aux environs de Paris que des individus jeunes ou de grandeur médiocre, mais qui se rencontre aussi en Piédmont et aux environs de Florence, d'où l'on en a des individus tout-à-fait developpés. La figure citée dans les vélins du Muséum représente un de ces derniers; c'est une coquille fort inéquilatérale, en cœur oblique, à valves fort épaisses, surtout vers la charnière, et qui a un décimètre de longeur (plus de 3 pouces et demi), sur une largeur de 92 millimetres (3 pouces 5 lignes).

Elle est ornée a l'extérieur de 22 à 25 côtes longitudinales,

simples, aplaties, et qui vont en s'élargessant vers le bord supérieur des valves. Le bord interne de chaque valve est denté en scie; les crochets sont très-protubérans, recourbés et dirigés vers le corcelet on la place de la lunule. La charnière est fort épaisse, et offre sur un plancher un demi-diaphragme, deux dents oblongues, inégales, obliques, dirigées vers la crochet. Outre les deux impressions musculaires, on voit, dans chaque valve, sous le corcelet, une fossette arrondie qui semble être un point d'attache de quelque partie de l'animal.

"Les individus plus jeunes des environs de Paris sont un peu moins inéquilatéraux, moins oblique que ceux d'Italie; ils paroissent d'ailleurs leur resembler en tout. Ils constituent la variété β de cette espèce."

The localities given below for this species are for the typical form as represented by the figure cited.

Localities.—ALABAMA: Palmer's mill, Wilcox Co., bed 21, sect. p. 31; Josh Hunter's, Hamburg, between Snow Hill and Allenton, bed 19; on Pine Barren creek, S. of Snow Hill, bed 19; McConnico's, 1½ mi. S. W. of Palmer's mill, bed 18; Mr. Cole's, W. of Palmer's mill, bed 18; ½ mi. N. of Snow Hill, "off-set"; 1 mi. S. W. of Clayton, Barbour Co.; 1⅓ mi. N. E. of Clayton, Barbour Co.

GEORGIA: Near the mouth of Sandy creek, Chattahoochee river; base of Midway, Chattahoochee river.

At the last mentioned two localities the specimens have broad flat ribs but are crossed by strong or deeply impressed concentric lines.

Venericardia planicosta var. *smithi*, { Pl. 4, fig. 14; Pl. 5, figs. 1, 2.

Syn. *V. planicosta* Har., Geol. Surv. Ark., vol. ii, 1892, p. 42.
V. smithii Ald., Geol. Surv. Ala., 1894, p. 243, pl. 12, figs. 1, a, b.

Aldrich's original description.—"Shell large, solid, slightly transverse, inflated, inequilateral, strongly ribbed, beaks strongly recurved, elevated; ribs 32-35 on specimens figured, flat in central part, strongly tuberculated both on the anterior and posterior, more faintly marked on the central part; teeth nearly transverse, cavity of shell deep, margin crenulate, cicatrices slightly impressed.

"Differs from *V. alticostata* Con. (*transversa* Lea) in the flat-

ness of the ribs. Fig. 1 is from a specimen in my collection, the other (1b) is in the State collection. Rather abundant. Named in honor of Dr. Eug. A. Smith."

The giving of this form a new specific name is justifiable or not, according to one's idea as to what constitute specific differences. If one should confine his attention to a few specimens collected at random from beds 18 and 19 at various places from Prairie Bluff to Allenton, it would be possible generally to say that certain forms have from 30 to 35 high narrow crenulated ribs, while others have from 26 to 30 lower, broader, smoother ones. Still the writer has experienced even in this limited area and geological horizon considerable difficulty in making this distinction. If, however, we widen our range both geographically and stratigraphically matters begin to become more seriously complicated. On the Chattahoochee river at the very base of the Midway, the lower, broader ribbed and more typical form is sharply marked with deep concentric lines. In the vicinity of Crainesville, Tenn., the ribs though high, narrow and crenulate, have decreased in number to 25 or 26. The specimens collected by Dr. Safford and referred to by Gabb (Jr. Ac. Nat. Sci. Phila., 1860, vol. iv, p. 395) as *C. subquadrata?* are a little different still;—the tops of the ribs are rounded or flattened and are about as broad as the interspaces, near the umbones, or in young specimens each rib is placed upon a low, broader rib somewhat after the nature of the costation in *V. alticostata* Con.; this feature soon dies out however, leaving the ribs as Gabb has remarked "of nearly the same shape as *C. planicosta* of the Eocene formation." To us the most remarkable feature of Dr. Safford's specimens is the paucity of ribs, numbering from 20 to 23 only. The compound ribbing and the crenulation on the superimposed ribs have been noticed in very young specimens of *V. planicosta* many times from different horizons and localities, but in these specimens it occasionally shows, though faintly, nearly to the margin. Although there is no doubt as to the affinity of these specimens, our collections from west Tennessee are too imperfect to determine the geographical range or importance of this form, hence we forbear from giving it a new varietal name.

We see no special reason for confounding the variety *smithi* with *alticostata;* the two seem quite distinct so far as our present collections and knowledge go.

It seems reasonable to suppose that when such a hardy animal as *V. planicosta* had been introduced into *terra nova* as it was in the Midway of our Southern States, it would, if the conditions were favorable, multiply rapidly, and as the sea changed or alternated from a limestone forming, to a sand or clay depositing

medium, this vigorous species would naturally cast off varietal forms, and it is these with which we now have to deal.

Localities for typical *smithi*.—

ALABAMA: 1 mi. N. of Midway, old field, Wilcox Co.; 1 mi. S. of Palmer's mill; 1½ mi. S. W. of Palmer's mill; Cole's place, W. of Palmer's mill; Pine Bareen creek, 2 mi. S. of Snow Hill; Josh Hunter's, between Snow Hill and Allenton.

ARKANSAS and TEXAS: This variety is also found in the Midway of these States.

Localities of Dr. Safford's and like specimens.—

TENNESSEE: 2 mi. E. of Middleton; 2 mi. S. S. E. of Middleton.

ALABAMA: 2 mi. N. of Snow Hill.

GEORGIA: Not far above the mouth of Sandy creek, on the Chattahoochee river.

Localities of the specimens with about 25 narrow, high ribs.—

TENNESSEE: Hannah's, 1¾ mi. N. E. of Crainesville, beds *b*, *d* & *f*; Huddleston's; 3 mi. W. of Crainesville; ½ mi. W. of Hannah's; McDonald's mill, 4 mi. S. W. of Middleton.

MISSISSIPPI: Reeves, 2½ mi. N. W. of Walnut; Blue Mt.

ASTARTE.

Astarte smithvillensis var. *mediavia*, Pl. 5, fig. 4.

Var. of *A. smithvillensis* Har., Proc. Ac. Nat. Sci. Phila., 1895, p. 48, pl. 1, figs. 8, a; 9, a, b, c.

Harris' original description.—"Size and general form as indicated by the figures; surface in typical specimens marked by strong concentric rugæ especially towards the base; these slope gently above but abrupt below and are superimposed by fine striæ; umbones flattened.

"This species shows great variation in form and size as well as markings. At Collier's Ferry, some specimens are more elongated, others more rotund; some have crenulations on the interior submargin, while others are smooth. Several of these forms are shown by the figures cited.

"*Localities of the typical form.*—Devil's Eye, Colorado river, Bastrop Co.; Smithville, Bastrop Co., Texas.

"*Geological Range.*—Lower Claiborne Eocene.

"*Types.*—Texas State Museum."

The species for which the varietal name, *mediavia*, is proposed are more oval in outline than the typical form, the rugæ are less distinctly defined and are no more abrupt below than above; they have a tendency to disappear on the anterior and posterior parts of the shell. Yet the shape of the young shell and its markings as determined by the umbones of the adults in hand, and the fact that *smithvillensis* has the capability of extreme variation in one and the same horizon, have weighed strongly in causing this form to be regarded as but a variety of that species rather than as distinct and new.

Localities.—ALABAMA: Naheola Landing, Tombigbee river; Matthews' Landing, Alabama river.

Type of the variety.—Lea Memorial Collection, Ac. Nat. Sci., Phila.

Astarte subpontis n. sp., Pl. 5, figs. 5, a, b.

Specific characterization.—Size and general form as indicated by the figures; extremely gibbous; marked exteriorly by concentric striæ near the beak, becoming stronger or fold-like near the lower margin; inner margin crenulate; teeth and muscular scars typical of the genus.

Locality.—GEORGIA: In the whitish limestone at the very top of the Midway horizon as represented on the Chattahoochee river. Common.

Type.—Paleontological Museum, Cornell Univ.

Astarte aldrichiana n. sp., Pl. 5, figs. 6, a.

Specific characterization.—General form and size as indicated by the figures; surface covered by strong, even, concentric lines; hinge of right valve with one strong umbonal tooth, before and behind which are pits for the teeth of the opposite valve; an anterior groove for a rather long anterior lateral and a posterior ridge answering for a posterior lateral, are present; shell polished within; muscular scars faintly impressed; marginal crenulation coarse.

This shell has the dentition of *A. concentrica* of the Miocene of Virginia. Except in size and faintness of muscular impressions this is an ordinary *Astarte*.

Locality.—ALABAMA: Dale's Branch, near Oak Hill, Wilcox Co.

Type.—Paleontological Museum, Cornell Univ.

CRASSATELLA.

Crassatella gabbi, Pl. 5, figs. 7, a, 8, 9 10, 11.

Syn. *C. pteropsis* Gabb, *non* Con., Jr. Ac. Nat. Sci., Phila., vol. iv, 1860, p. 395, pl. 68, fig. 28.
C. gabbi Safford, Am. Jr. Sci., II, vol. xxxvii, p. 368, 1864.
Crassatella sp. Harris, Geol. Surv. Ark., 1892, vol. ii, p. 43.
C. tumidula Ald., Geol. Surv. Ala., 1894, p. 242.

Gabb's original description.—"Subtriangular, flattened; beaks very small; in some specimens a slight depression in advance of the umbonal ridge, which is rounded; surface marked by heavy transverse ribs, which become faint on and behind the umbonal ridge; hinge rather small; muscular scars deeply impressed; cardinal margin straight, anterior margin regularly rounded, basal margin slightly sinuous, posterior subangular.

"*Dimensions.*—Length, .9 in., width, 1.4 in., height of valve, .2 in.

"*Locality.*—Ripley group, Hardeman Co., Tenn., Prof. Safford; and from the same formation at Eufala, Ala. Collection of the Smithsonian Institution, No. 553."

Gabb's description answers fairly well to the type specimen in Dr. Safford's collection, a figure of which is herewith given.

His "dimensions," however, were evidently taken from the Smithsonian specimen.

Since Conrad had previously proposed the name *pteropsis* for a species of *Crassatella*, it was eminently proper for Dr. Safford to rename this species in Gabb's honor.

Several years ago the writer encountered this species in the Midway of Arkansas, and from the great variety of forms it presented, supposed that there were two species. However, none were well enough preserved to admit of positive identification or clear description, hence they were passed by un-named.

In Texas one of the same forms has been found in the Midway on Brazos river. A manuscript name was proposed but the description was never printed. The figure of that form is given on pl. 5, figs. 10, 11.

If all the specimens in hand at present really represent but one species, as seems most likely, it presents a remarkable amount of variation in shape and surface markings. In the type specimen and all specimens from near Middleton sent here by Dr. Safford, there are a dozen or more strong concentric folds on the medial and anterior portion of the valve, but posteriorly,

or behind the sinus anterior to the umbonal ridge, the folds disappear and the shell is smooth.

The lower or basal portion of the valve is also smooth. Other specimens are covered with much finer folds to the basal margin, while on others the markings are nearly obsolete.

One internal feature of this species is worthy of note, viz., the extreme obliquity of the cartilage pit (see figures). This is practically the same as seen in *C. alæformis*. The last mentioned species, however, differs considerably from *C. gabbi*. Its umbones are flat, its lirations broader, and the length of the shell is far greater.

Localities.—TEXAS: Brazos river, at Cretaceous–Eocene contact; Brazos river, Milam–Falls Co. line (see pl. 5, fig. 10, 11); Rocky Cedar creek, public road crossing, Kaufman Co.; Briar creek, northern part of Gibb's survey, northern Milam Co.; near Webberville, Travis Co.

ARKANSAS: N. W. of S. E. ¼, Sect. 8, 1 S., 13 W., and half a mile S.; Sect. 36, 1 S., 16 W.

TENNESSEE: Type specimen, 2 mi. S. of Middleton (pl. 5, fig. 7, a); others 2 mi. E. of Middleton; Hannah's, 1¾ mi. N. E. of Crainesville, Hardeman Co., bed *b*; ½ mi. W. of Hannah's; Huddleston's, 3 mi. W. of Crainesville; McDonald's mill, 4 mi. S. W. of Middleton.

MISSISSIPPI: Reeves, 2½ mi. N. W. of Walnut.

ALABAMA: ? ¾ mi. W. of Prairie Bluff, bed *e* (casts only); ¼ mi. N. W. of Prairie Bluff, old field; 1½ mi. S. W. of Palmer's mill, at S. McConnico's; roadside, 1 mi. S. of Palmer's mill (pl. 5, fig. 8); 1⅓ mi. N. E. of Clayton.

GEORGIA: The station mentioned in my Arkansas Report, vol. ii, p. 43, as 3 mi. below the mouth of Pataula creek, is probably on the Georgia side of the Chattahoochee.

Crassatella sepulcollis n. sp., Pl. 6, fig. 1.

Specific characterization.—Size and general form as indicated by the figure; beaks, anterior, prominent, curving anteriorly; young shell nearly quadrangular and strongly marked with distant rugæ; becoming elongate and smooth with age; lunule deep, well but not sharply defined; escutcheon well defined, extending from beak to a little over two-thirds way to posterior–dorsal angle; post–umbonal slope broad; cartilage pit small, extending

from beak to midway of the cardinal plateau; two cardinal teeth of left valve of equal size, lunule margin extending from beak downwards and outside of the anterior tooth, leaving a slight crease between the two, and then continuing downward with a slight inflection and forming a pseudo-lateral tooth; cardinal tooth in right valve large, triangular with a pit on either side for the reception of the teeth of the opposite valve; the margin of the escutcheon in this valve answering for a faint posterior lateral tooth; submargin generally smooth, but often crenulate at some little distance in from the actual periphery of the shell.

This species is very abundant in the vicinity of Graveyard hill, beds 15 and 16?. Its high, anteriorly located and curving beaks, its broad post-umbonal slope, its hinge characters, and size and general outline distinguish it from any other known form.

Localities.—ALABAMA: ½ mi. W. of Graveyard hill; 1 mi. N. of Allenton.

PROTOCARDIA.

Protocardia nicolletti var., Pl. 6, fig. 2.

Var. of *C. nicolletti* Con., Proc. Ac. Nat. Sci. Phila., 1841, p. 33.
C. nicolleti Con., Wailes' Ag. and Geol., Miss., 1854, pl. 14, fig, 6.

Conrad's original description of C. nicolletti.—"Cordate, ventricose, polished, with crowded, minute, impressed radiating lines; beaks central, summits very prominent; posterior margin nearly direct, slightly emarginate, posterior slope with larger striæ than the disk, and muricated with radiating rows of approximate, rather obtuse, slender and prominent tubercles. Length, 2½ inches. Height the same.

"For this splendid *Cardium* I am indebted to my distinguished friend, J. N. Nicollet. It was found in green clay at 50 feet in height on the right bank of the Washita river, Monroe county, Louisiana."

I am quite aware that this variety differs considerably from the typical form. In brief the differences may be stated as follows:

In the typical form the anterior and posterior dorsal margins are prominent, in the variety they are obliquely truncated; in adult typical forms the basal margin is often circular, in the variety nearly rectilinear.

The Lignitic specimens from Virginia and Alabama, named *P. lene* and afterwards *P. virginiana* by Conrad, have the general shape of this variety except that the umbones instead of being

even more prominent than in *nicolletti* typical, are much smaller.

After having collected large numbers of this genus from different horizons it will be possible to speak more positively of these allied forms.

Localities of this variety.—

TENNESSEE: Hannah's, 1¾ mi. N. E. of Crainesville, bed *b;* Huddleston's, 3 mi. W. of Crainesville.

MISSISSIPPI: Blue Mt., S. W. of Ripley; Reeves, 2½ mi. N. W. of Walnut.

ALABAMA: Naheola, Tombigbee river, (Best specimens found here); 1 mi. N. of Prairie Bluff; Dale's Branch, near Oak Hill; 1 mi. S. W. of Clayton.

Specimen figured.—Paleontological Museum, Cornell Univ.

CHAMA.

Chama gainesensis n. sp., Pl. 6, figs. 4, a.

Specific characterization.—General form and size as indicated by the figure of the internal cast; valves of nearly equal size and very similar throughout; umbones sometimes much stronger than represented by the figure, distant; umbonal ridge fairly well marked, anterior to which, or nearly in the central portion of the valve, a slightly impressed, broad sinus extends from beak to base; exterior with strong, wide, rather thick and irregular lamellæ.

Locality.—GEORGIA: Uppermost bed of the Midway limestone as exposed on the Chattahoochee river at Ft. Gaines. Common.

Types.—Paleontological Museum, Cornell Univ.

ISOCARDIA.

Isocardia mediavia n. sp., Pl. 6, fig. 5.

Specific characterization.—Size and general form as indicated by the figure; beaks strongly in-rolled; umbonal ridge rather sharp above, but less so below; shell very ventricose, the depth of the valve figured being 12 mm.; surface smooth about the umbo, but marked with concentric lines towards the basal margin.

Traces of this species have been seen from the Midway limestone of Texas, and from the clays of Black Bluff, Tombigbee river, several years ago, but this is the first large, well preserved valve found.

Localities.—ALABAMA: Black Bluff, Tombigbee river; Matthews' Landing, Alabama river (Fig'd type); 1 mi. N. of Midway (horizon of bed 18, sect. p. 31).

MERETRIX.

Meretrix ripleyana, Pl. 6, fig. 6.

Syn. *Venus ripleyana* Gabb, Jr. Nat. Sci, Phila., vol. iv, 1860, p. 393, pl. 68, fig. 22.

Gabb's original description.—"Inequilateral; beaks small, anterior; cardinal margin strongly curved, anterior semicircular, basal and posterior regularly rounded, surface marked with regular transverse ribs.

"*Dimensions.*—Length .55 in., width .7 in., diameter .38 in.

"*Locality.*—Ripley group, Hardeman Co., Tenn. Prof. Safford."

Nearly all the type specimens of this species were from a clay bank 2 miles S. S. E. of Middleton, Tenn. One specimen, however, is from 2 miles E. of Middleton, and another is from the limestone on Muddy creek. The specimen that Gabb used in his description and which he figured is probably the one now represented by the blue clay filling, the shell having been exfoliated. However, several other fairly well preserved specimens show the character of the species. One is figured herewith. This is perhaps not quite so elongated as the majority of the specimens; there seems to be considerable variability in this regard. The concentric rugæ are fairly strong and regular from the middle of the valve downwards, while upwards towards the beaks the shell is nearly smooth. All the specimens from Dr. Safford are approximately the same. The lunule is rather narrow and long, giving that margin of the shell an unusual straightness from the umbo to the anterior end.

In Georgia casts of this species occur at the very base of the Midway on the Chattahoochee river, and thence to the mouth of Sandy creek. Another slightly larger variety occurs in the cuts north of Snow Hill, off-set of the section on p. 31.

Fig. 7 is from Huddleston's, 3 miles W. of Crainesville, Tenn. The same form occurs in U. S. Nat. Museum material brought from 4 miles N. E. of Kemp, Kaufman Co., Texas.

Meretrix sp.

While at work on the Arkansas and Texas State Surveys, the writer frequently found casts of this genus in the Midway lime-

stones. Some of these were figured. They are so variable in form, however, that it has seemed and still seems unwise to attempt specific descriptions of them. In a future work it is intended to go over all Eocene genera systematically and the then accessible material will doubtless be far more satisfactory than that which we now possess.

The commonest *Meretrix* in the Alabama Midway is nearly circular in outline below, but with a very strong umbonal region, marked evenly on its exterior with concentric rugæ. This is a very common form in the horizon of beds 18 and 19 in Wilcox Co., and in the R. R. cut 1⅓ miles N. E. of Clayton, Barbour Co. It is also found in the limestone of Limestone Co., Texas.

TELLINA.

Tellina, Pl. 6, fig. 8.

The specimen shown by the figure was found with many others in bed *f*, at Hannah's, p. 18. Since all are mere casts it seems unwise to give them a new specific name.

Another species more like Aldrich's *T. triangularis* was found along the Chattahoochee. Doubtless more perfect specimens of both species will be found in the course of a few years.

CORBULA.

Corbula subcompressa, Pl. 6, fig. 9.

Syn. *C. subcompressa* Gabb, Jr. Ac. Nat. Sci., Phila., vol. iv, 1860, p. 394, pl. 68, fig. 24.

Gabb's original description.—"Subquadrate, beaks nearly central; umbones large, umbonal ridge angular, umbonal slope abrupt, anterior margin regularly rounded, posterior slightly sinuous, posterior subbiangular; hinge very small.

"*Dimensions.*—Length .14 in., width .22 in.

"*Locality.*—Two miles E. of Middleton, Hardeman Co., Tenn.

"This species resembles closely *C. compressa* Lea, from the Eocene of Ala., although it is undoubtedly distinct.

Both of Gabb's types are left valves. The specimen he figured is probably not the same one shown on pl. 6, fig. 9, but it has essentially the same form. In just the right light a trace of a radiating sinus is observable anterior to the umbones and another just anterior to the umbonal ridge.

Type specimens.—R. R. cut, 2 mi. E. of Middleton, Tenn., now in Dr. Safford's collection, Vanderbilt University, Tenn.

Casts of this species are common in the limestone ledges of the Midway on the Chattahoochee river above Sandy creek. They are slightly longer than the types. Another specimen from the basal layer is like the types. Higher in the Midway stage, at Matthews' Landing on the Alabama river, a thicker, higher form occurs which is doubtless the descendant of the typical form. Similarly higher forms occur in bed *f* at Hannah's, p. 18, and a more nearly typical form was figured by the writer from the Midway limestone of Arkansas; see Ann'l Rep't State Geol. Surv., 1892, vol. ii, pl. 1, fig. 6.

LUCINA.

Lucina claytonia n. sp., Pl. 6, figs. 10, a.

Specific characterization.—Size and general outline as indicated by the figures (of different individuals); surface but slightly striate near the umbones, but near the periphery showing several (4 to 5) distinct halts in the growth of the shell, finely and evenly striate between these growth lines; lunule small, impressed, ligamental groove large and deep, bordered posteriorly by a slightly elevated ridge in the right valve; cardinal teeth two in each valve; anterior lateral faint in either valve; muscular scars unequal as figured.

The figures are from gutta-percha impressions. Imprints of this species are very common in the limestone outcrop near Clayton.

This species varies somewhat in form but it generally has a trace of a posterior truncation. The shell is rather thin.

I know of no similar Eocene species with which this may be compared. In general outline it resembles some of the very large specimens of *Mysia ungulina* from Claiborne but its muscular scars remove it far from that form. In some respects perhaps this may be said to resemble *L. symmetrica* also from the Claiborne sands, but that is much larger, thicker, with differently shaped teeth and ligamental pit and is more nearly circular in outline; there are also several other points of difference.

Locality.—ALABAMA: R. R. cut, 1⅓ mi. N. E. of Clayton.

Types.—Paleontological Museum, Cornell Univ.

Lucina fortidentalis n. sp., Pl. 6, figs. 11, a.

Specific characterization.—Size and general form as indicated by the figures; surface marked by (10 to 12) sharp, raised, concentric, lamellar rugæ, between which are faint concentric lines;

both cardinal and lateral teeth well developed; right valve with one strong and one rudimentary anterior lateral and one strong and one rudimentary posterior lateral—all short, one cardinal tooth; left valve with two tooth-like projections fitting over both strong anterior and posterior laterals, and two cardinal teeth; ligament external, extending from the umbo to near the posterior lateral teeth; muscular scars as shown in the figure; inside of the valves coarsely punctate.

Localities.—ALABAMA: 1 mi. N. of Midway.
GEORGIA: Base of Midway, Chattahoochee river; soft layer of gray, micaceous clay with casts of large *Turritella mortoni*, not far north of the mouth of Sandy creek, Chattahoochee river.

GASTROCHÆNA.

Gastrochæna gainesensis n. sp., Pl. 6, figs. 12, a.

Specific characterization.—General form as indicated by the figures, though the posterior is represented as somewhat too narrow since the posterior–dorsal margin is broken away; size one-half that represented in the figures; shell extremely gibbous anteriorly, with a great anterior–basal opening; main face of shell somewhat more coarsely striate than anterior portion, *i. e.*, that in front of a vaguely defined line of flexture by no means as distinct as in *Martesia;* found as is common for this genus surrounded by a globular or pear-shaped incrustation.

Locality.—GEORGIA: Uppermost layers of the Midway limestone as exposed on Chattahoochee river at Ft. Gaines.

Type.—Paleontological Museum, Cornell Univ.

Gastrochæna cimitariopsis n. sp., Pl. 6, fig. 13.

Specific characterization.—General form as indicated by the figure; figure twice natural size; marked exteriorly by a few concentric undulations; a strong ridge extending from the umbo to the posterior–basal margin, posterior to the same the shell is nearly flat, with a trace of a radiating sinus; anterior–basal margin widely gaping; surrounded by an elongate globular covering like other members of the genus. Rare.

Locality.—GEORGIA: Uppermost bed of the Midway limestone as seen on Chattahoochee river at Ft. Gaines.

Type.—Paleontological Museum, Cornell Univ.

MARTESIA.

Martesia dalliana n. sp., Pl. 6, fig. 15.

Specific characterization.—General form as indicated by the figure which is 1⅔ natural size; subcylindrical in cross-section; strongly characterized by the faintness or practical absence of the groove that generally in this genus extends from the umbo obliquely backwards to the basal margin; anterior end narrow, covered with concentric, rather strong striæ, which as they pass around an anterior umbonal carina are bent downwards nearly at right angles, and again some distance below are deflected backwards; at the point of backward deflection there is a very faint trace of the groove mentioned above.

Locality.—GEORGIA: Near the base of the Midway stage on the Chattahoochee river not far above the mouth of Sandy creek.

Type.—Paleontological Museum, Cornell Univ.

VERTICORDIA.

Verticordia sp., Pl. 6, fig. 16.

The specimen figured being the only one obtained from the Midway it seemed best to defer its specific characterization until its relations with *V. eocense* Langdon, can be determined. It is very much smaller than Langdon's species and from the figure of it by Aldrich (Bull. Geol. Surv. Ala., No. 1, 1886, pl. 6, fig. 13), it is considerably different in form. How much of this difference may be due to age connot at present be determined.

Locality.—ALABAMA: 1 mi. W. of Oak Hill P. O., Wilcox Co.

Specimen figured.—Paleontological Museum, Cornell Univ.

PHOLADOMYA.

Pholadomya mauryi n. sp., Pl. 6, figs. 17, a.

Specific characterization.—General form as indicated by the figures; surface nearly smooth posteriorly, but marked on the anterior slope by several light costæ increasing in strength from those nearest the superio-anterior margin to those extending from beak to anterior margin on the right valve, inclined to alternate in size; posteriorly from the seventh or eighth of these strong ribs there are as many more faint ones on the medio-anterior portion of the shell; concentric undulations not strongly

marked though present; superio-anterior margin suddenly reflected and highly elevated leaving a slight open space; anterio-subbasal margin entire as indicated by a perfect imprint of the right valve of the type; but strangely enough the lines of growth show that when young this margin was gaping and was filled by a callus plate as in *Pholadidea* when mature.

Though the dissimilarity in outline of this species to any known form is well marked, its other peculiarites are very closely represented by *Pholadomya cuneata*. Deshayes remarks regarding the latter species (Descr. des An. sans Vert., etc., 1858, vol. i, p. 277; see also pl. 9, figs. 6-8): "Ce qui la rend surtout remarquable, c'est une sorte de lobe médian, produit par une saillie considérable de l'angle supérieur des valves qui remonte entre les crochets, atteint leur hauteur et s'infléchit un peu vers eux; les valves laissent entre elles une fente longue et lancéolée qui commence au lobe supérieur et se termine vers le bord ventral [This feature is more noticeable in *cuneata* than in *mauryi*]; en examinant les stries d'accroissement, on s'aperçoit bientôt que dans le jeune âge le côté antérieur devait être ouvert largement à la manière de certaines Pholades, *Pholas dactylus* par example; des côtes longitudinales, partant du crochet, descendent en se courbant sur le côté antérieur, et viennent aboutir à la limite du bâillement de la coquille lorsqu'elle était jeune, et de ce point, au lieu de continuer à descendre, elles deviennent horizontales et même sont peu ascendantes; ces côtes étroites, egalement distantes, sont traversées par des stries transverses écartées, qui par leurs entre-croisement forment une sorte de réseau à grandes mailles; sur le côté postérieur les côtes disparaissent complétement, tandis que les stries transverses persistent. Le bâillement du côté postérieur est peu considérable, il semble même que la coquille est parfaitement fermée de ce côté; mais cela est produit probablement par une légère compression," etc., etc.

This and several other species of *Pholadomya* from the Thanet Sand may be seen in the collections of the British Museum; some of them occur too in a similar horizon in the Paris basin, horizon de Bracheux. It is therefore interesting to find in our Midway Eocene, a species conforming to *P. cuneata* in several noteworthy features, though specifically very distinct.

Localities.—TENNESSEE: Light gray sandstone layer at Hannah's (bed *b*), Hardeman Co. This sandstone shows numerous burrowings of this and other bivalves. Also from lower portion of section at Huddleston's.

Scaphopoda.

DENTALIUM.

Dentalium mediaviense, Pl. 7, figs. 1, a.

Syn. *D. mimutistriatum* Dall, *partim*, Trans. Wag. Fr. Inst. Sci., vol. iii, p. 438.

Specific characterization.—Size and general form as shown by the figures; surface nearly smooth near the greater extremity, though showing some irregular slight annulations; above, becoming longitudinally striate with alternating fine and coarse lines, annulations plainly visible and very regular; shell, about larger aperture very thin, but becoming very thick within half an inch of this extremity.

After examining hundreds of *D. minutistriatum* from typical localities in Texas, the writer noted in his MS. report on the Mollusca of that State that the Prairie creek, Ala., specimens had certain marked characters not possessed by *minutistriatum*. The Midway species are large, sometimes quite large and attaining a maximum diameter of ⅓ inch; their striation is very plainly alternate and sometimes becomes quite strong towards the apex; they have clearly defined and regular annulations; they are much more tapering than *minutistriatum*.

Localities.—MISSISSIPPI: ½ mi. N. of Ripley.
ALABAMA: Black Bluff; ½ mi. W. of Graveyard hill; ? Dale's Branch; 1 mi. N. of Allenton.

Type.—Paleontological Museum, Cornell Univ.

CADULUS.

Cadulus turgidus, Pl. 7, fig. 2.

Syn. *C. turgidus* Meyer, Bull. No. 1, Geol. Surv. Ala., 1886, p. 65, pl. 1, fig. 10.

Meyer's original description.—"Width of the shell rapidly increasing for about two-thirds of the entire length, and then more rapidly decreasing; section circular.

"*Locality.*—Matthews' Landing, Ala.

"Rather common; I received this shell from Mr. Aldrich. It differs by its very strong inflation from all the other species of *Cadulus* of the Southern Tertiary which I know of."

Localities.—ALABAMA: Matthews' Landing; 1 mi. W. of Oak Hill; Dale's Branch.

Gastropoda.

ACTÆON.

Actæon (*Tornatellæa*) *bella*, Pl. 7, fig. 3.

Syn.—*T. bella* Con., Jr. Ac. Nat. Sci., Phila., vol. iv, 1860, p. 294, pl. 47, fig. 23.

Conrad's original description of the sub-genus.—"Ovate, ventricose; columella with two slender, prominent folds, the lower fold not distinctly continuous with the margin of the base.

Specific description.—"Ovate; spire conical; revolving lines numerous, impressed, punctate-striate."

Conrad does not give the exact locality of this species, but we know it to be very abundant in the Lignitic of Alabama.

Localities.—MISSISSIPPI: 1 mi. N. of Ripley (see fig.)
ALABAMA: Black Bluff, Tombigbee river; 1 mi. N. of Midway, Wilcox Co.

Type.—Ac. Nat. Sci., Phila.

Actæon (*Tornatellæa*) *quercollis* n. sp., Pl. 7, fig. 4.

Specific characterization.—General form as shown by the figure; spire usually broken at apex, remaining whorls slightly shouldered above but becoming more rectilinear below, traces of lines of growth sometimes present, spiral striæ rather faint; body whorl somewhat shouldered, sides rather straight, spiral striæ fainter above and stronger below; columella in adult specimens with two well marked folds; aperture truncated anteriorly; labrum thin at margin, strongly lirate and varicose within.

Localities.—ALABAMA: The best specimens in hand are from the National Museum, Stations 264 and 283, Wilcox Co. They are doubtless from bed 9, section p. 31. Others in the University collection are from ½ mi. W. of Graveyard hill, Wilcox Co.
TENNESSEE: Small specimens, probably of this species, are from Hannah's, bed *f*, 1¾ mi. N. E. of Crainesville.

Type.—Collection U. S. Nat. Museum.

ATYS.

Atys robustoides?, Pl. 7, fig. 5.

Syn. *Atys robustoides* Ald., Bull. Am. Pal., No. 2, p. 6, pl. 2, figs. 4, 4a, 1895.

Aldrich's original description.—"Shell small, oval, subgibbous, striated, umbilicated; lines of growth numerous, more so on the posterior half of the shell; spirals numerous, more closely set at extremities and rather deeply cut, no pitting of the lines perceptible; posterior end rising above apex and partly covering the posterior pit; the callus twisting into a saddle shape to join the outer lip; spirals closely set where they run up into the umbilicus; pillar lip nearly straight.

"*Locality.*—Gregg's Landing, Alabama."

The little specimen shown by fig. 5 has been broken posteriorly, and it is difficult to identify it specifically with any form heretofore described. It is perhaps *A. robustoides* Ald., and is from 1 mile west of Oak Hill, Wilcox Co., Ala.

Specimen figured.—Paleontological Museum, Cornell Univ.

CYLICHNA.

Cylichna meyeri, ... Pl. 7, fig. 6.

Syn. *Cylichna meyeri* Ald., Bull. Am. Pal., No. 2, p. 6, pl. 2, fig. 5.

Aldrich's original description.—"Shell cylindrical, narrow, thin, lines of growth prominent and closely set on the posterior, becoming obsolete on the middle part of the shell; spiral lines numerous, closely set, impressed slightly and showing very faintly through the lines of growth at the posterior end; a deep excavation running from aperture at posterior over the apex and connecting to outer lip which projects above the opening, a strong rounded ridge marking the connection with the edge of whorl; aperture narrow at posterior, widening at anterior, the callus thickening but without a fold, umbilicus rudimentary.

"*Locality.*—Matthews' Landing, Ala.

"Differs from *C. dekayi* Lea by its groove at posterior, the sudden thickening of lines of growth and the absence of a fold. Named in honor of Dr. Otto Meyer."

The only specimen collected during the summer by us was from 1 mile west of Oak Hill P. O., Wilcox Co., Ala. Bed 9 of Oak Hill section, p. 31. It is fragmentary and is shown by fig. 6.

Type.—Aldrich's Collection.

Cylichna sp., ... Pl. 7, fig. 7.

An imperfect specimen of perhaps *C. galba* Con.; from Naheola, Tombigbee river, Ala.

Specimen figured.—Paleontological Museum, Cornell Univ.

Gastropoda.

ACTÆON.

Actæon (*Tornatellæa*) *bella*, Pl. 7, fig. 3.

Syn.—*T. bella* Con., Jr. Ac. Nat. Sci., Phila., vol. iv, 1860, p. 294, pl. 47, fig. 23.

Conrad's original description of the sub-genus.—"Ovate, ventricose; columella with two slender, prominent folds, the lower fold not distinctly continuous with the margin of the base.

Specific description.—"Ovate; spire conical; revolving lines numerous, impressed, punctate-striate."

Conrad does not give the exact locality of this species, but we know it to be very abundant in the Lignitic of Alabama.

Localities.—MISSISSIPPI: 1 mi. N. of Ripley (see fig.)
ALABAMA: Black Bluff, Tombigbee river; 1 mi. N. of Midway, Wilcox Co.

Type.—Ac. Nat. Sci., Phila.

Actæon (*Tornatellæa*) *quercollis* n. sp., Pl. 7, fig. 4.

Specific characterization.—General form as shown by the figure; spire usually broken at apex, remaining whorls slightly shouldered above but becoming more rectilinear below, traces of lines of growth sometimes present, spiral striæ rather faint; body whorl somewhat shouldered, sides rather straight, spiral striæ fainter above and stronger below; columella in adult specimens with two well marked folds; aperture truncated anteriorly; labrum thin at margin, strongly lirate and varicose within.

Localities.—ALABAMA: The best specimens in hand are from the National Museum, Stations 264 and 283, Wilcox Co. They are doubtless from bed 9, section p. 31. Others in the University collection are from ½ mi. W. of Graveyard hill, Wilcox Co.
TENNESSEE: Small specimens, probably of this species, are from Hannah's, bed *f*, 1¾ mi. N. E. of Crainesville.

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Specimen figured.—Paleontological Museum, Cornell Univ.

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Cylichna meyeri, Pl. 7, fig. 6.

Syn. *Cylichna meyeri* Ald., Bull. Am. Pal., No. 2, p. 6, pl. 2, fig. 5.

Aldrich's original description.—"Shell cylindrical, narrow, thin, lines of growth prominent and closely set on the posterior, becoming obsolete on the middle part of the shell; spiral lines numerous, closely set, impressed slightly and showing very faintly through the lines of growth at the posterior end; a deep excavation running from aperture at posterior over the apex and connecting to outer lip which projects above the opening, a strong rounded ridge marking the connection with the edge of whorl; aperture narrow at posterior, widening at anterior, the callus thickening but without a fold, umbilicus rudimentary.

"*Locality.*—Matthews' Landing, Ala.

"Differs from *C. dekayi* Lea by its groove at posterior, the sudden thickening of lines of growth and the absence of a fold. Named in honor of Dr. Otto Meyer."

The only specimen collected during the summer by us was from 1 mile west of Oak Hill P. O., Wilcox Co., Ala. Bed 9 of Oak Hill section, p. 31. It is fragmentary and is shown by fig. 6.

Type.—Aldrich's Collection.

Cylichna sp., Pl. 7, fig. 7.

An imperfect specimen of perhaps *C. galba* Con.; from Naheola, Tombigbee river, Ala.

Specimen figured.—Paleontological Museum, Cornell Univ.

PLEUROTOMELLA.

Pleurotomella whitfieldi, Pl. 7, fig. 8.

Syn. *Fusus? whitfieldi* Ald., Bull. Am. Pal., No. 2, 1895, p. 11, pl. 4, fig. 4.

Aldrich's original description.—"Shell thin, broadly fusiform, whorls ten, first four smooth, the next partly smooth and partly transversely ribbed, the balance angulated with ribs on the lower half of whorl; surface reticulated; the spiral lines alternate in size, very closely set, the smaller spiral line beaded on the body whorl; constricted at suture; outer lip sigmoid, smooth within; canal slightly bent.

"*Locality.*—Matthews' Landing and Gregg's Landing, Ala.

"This shell partakes so much of a Pleurotomid, I hesitate to put it under *Fusus.*"

Found also 1 mile west of Oak Hill P. O., from the Matthews' Landing horizon, bed 9, section p. 31.

Type.—Collection of T. H. Aldrich.

Specimen figured.—Paleontological Museum, Cornell University. From 1 mi. W. of Oak Hill.

PLEUROTOMA.

Pleurotoma (*Surcula*) *adeona,* Pl. 7, figs. 9, 10.

Syn. *P. adeona* Whitfield, Am. Jr. Conch., 1, 1865, p. 262.

Whitfield's original description.—"Shell fusiform; spire moderately high; volutions five, deeply concave on the upper side, carinate in the middle and rounded below; ornamented on the carina by strong, oblique nodes, about fifteen on the body whorl; columella long, straight, and, with the aperture, forming more than half the length of the shell; entire surface marked by fine revolving striæ, and crossed by lines of growth having a deep retral curvature on the concave portion of the volution.

"*Locality.*—Nine miles below Prairie Bluff, Ala.

This species shows considerable variation as regards carinations and strength and form of spines. The figures show two forms. Others are broader and more sharply carinate.

Localities.—ALABAMA: Matthews' Landing; Dale's Branch, near Oak Hill; 1 mi. W. of Oak Hill; ½ mi. W. of Graveyard hill; 1 mi. N. of Allenton.

Type.—Hall collection or lost.

Specimen figured.—Paleontological Museum, Cornell Univ.

Pleurotoma (*Surcula*) *persa*, Pl. 7, fig. 11.

Syn. *P. persa* Whitfield, Am. Jr. Conch., vol. i, 1865, p. 262, pl. 27, fig. 4.

Whitfield's original description.—"Shell broadly fusiform; volutions seven or eight, concave on the upper side, and rounded below, leaving a rounded ridge just above the suture line; columella elongate, very slender, and bent a little backwards near the lower extremity; aperture elliptical, not quite as long as the canal below, the two together forming about one-half of the length of the shell; deeply notched in the upper part; surface marked with very fine, closely arranged revolving lines, which are crossed by fine lines of growth, having a strong retral curvature on the upper part of the volution.

"*Dimensions.*—Length of shell 1.12 inches, transverse diameter .35 inch.

"*Locality.*—Nine miles below Prairie Bluff, Ala."

By this Whitfield means Matthews' Landing. It is also found abundantly by the roadside, 1 mi. W. of Oak Hill P. O.; also in Dale's Branch.

Type.—J. Hall collection.

Specimen figured.—Pal. Mus., C. U.; from Matthews' Landing.

Pleurotoma (*Pleurotomella?*) *anacona*, Pl. 7, fig. 12.

Syn. *P.* (*Pleurotomella*) *anacona* Harris, Proc. Ac. Nat. Sci., Phila., 1895, p. 56, pl. 4, fig. 4.

Harris' original description.—"General form as figured; whorls 8; 1 nearly or quite smooth; 2, 3, 4, 5, 6 with (*a*) a broad slightly concave band showing very faint spiral striæ and a deep retral curve in the longitudinal striæ, (*b*) a slight basal carina with two or three strong spiral lines and rather faint, slightly oblique nodules; body whorl with more or less alternating coarse and fine spiral lines from the nodose carina to the end of the beak.

"*Localities.*—Well at Elgin, northeast corner of Bastrop county; Smiley's Bluff, Brazos river, 2 miles above Pond creek, and perhaps on Rocky Cedar creek, 5 miles west of Elmo.

"*Geological horizon.*—Midway Eocene."

Type and specimen figured.—Texas State Museum.

This form resembles somewhat *Pl. adeona* Whitf., but differs by its longer form, smoother surface and the position of the posterior canal.

Pleurotoma (*Surcula*) *ostrarupis*, Pl. 7, fig. 13.

Syn. *Pl. ostrarupis* Harris, MS. prepared for 5th Ann'l Rep't Geol. Surv. Tex., pl. 15, fig. 5.

Harris' original description.—"This is only a fragment and cannot be fully characterized. The more obvious and peculiar features are: (*a*) the rather fine, oblique, and somewhat curved longitudinal costæ which in all probability disappear on the larger whorls of adult, and (*b*) the regular spiral striation.

"*Locality.*—Sta. 104, Smiley's bluff, Brazos river, two miles above the mouth of Pond creek, Milam Co.

"*Geological horizon.*—Midway Eocene.

"In the collection of the U. S. Nat. Mus., a specimen occurs among others marked '*Pleurotoma persa* Whitf.' by Aldrich. All came from Matthews' Landing. This particular specimen is evidently not *P. persa*, but, as far as can be determined, should be labelled *P. ostrarupis*."

This species is quite common in material from Matthews' Landing. When entire the general outline of the shell is not far from that of *Pl. anacona*. A small specimen is in the Pal. Mus., C. U., from 1 mile west of Oak Hill.

Type.—Texas State Museum.

Pleurotoma sp., Pl. 7, fig. 14.

This seems to be the forerunner of the Wood's Bluff form called by Heilprin in Proc. Ac. Nat. Sci., Phila., 1880, p. 374, "*Pleurotoma acuminata?* Sowerby." Its spire is not so high as the Lignitic form, and its costæ are fewer and more prominent, and its columella is more deflected at base. Nevertheless, since but one specimen of this variety is at hand, it seems inadvisable to designate it at present by any particular name.

Locality.—ALABAMA: Dale's Branch, near Oak Hill, Wilcox Co.

Specimen figured.—Paleontological Museum, Cornell Univ.

Pleurotoma longipersa n. sp., Pl. 7, fig. 15.

Specific characterization.—General form as indicated by the figure; spire of about seven whorls; 1, 2 and 3 smooth, 4 costate, these are embryonic; remaining spiral whorls with a subsutural band traversed by a revolving line, below with fine lines of growth and alternating spiral lines; carinations of 5 and 6 obliquely and faintly costate.

This species resembles *P. persa* and *P. gabbi;* from the former it is distinguished by its much more constricted sutures and the

subsutural band; from the latter it differs in having more constricted sutures, by having a tendency to costation in the upper spiral whorls, not embryonic.

Locality.—ALABAMA: Matthews' Landing.

Type.—Paleontological Museum, Cornell Univ.

Pleurotoma mediavia n. sp., Pl. 7, fig. 16.

Specific characterization.—General outline as shown by the figure; two embryonic whorls small, smooth, a third and a part of the fourth are longitudinally costate, finely so at first but becoming coarser below; on the four sub-embryonic spiral whorls there is a submedial carina traversed by fine costations not so sharply biangular as in *Pl. denticula* or *Pl. alternata*, but recalling those in *Pl. waterkeynii* as shown on pl. 30 of Edwards' Eocene Mollusca of England, 1860; spiral and longitudinal lines fine, though just beneath the carina the spirals are apt to be coarser; costations traversed by four fine spiral lines; costæ nearly obsolete on the body whorl.

A very closely related but larger form from Wood's Bluff has three lines traversing the costæ, while *Pl. alternata* and *Pl. childreni* have but two.

Locality.—ALABAMA: 1 mi. W. of Oak Hill P. O., Wilcox Co.

Type.—Paleontological Museum, Cornell Univ.

Pleurotoma (*Cythara?*) *leania* n. sp., Pl. 7, fig. 17.

Specific characterization.—Size and general form as indicated by the figure; three or four embryonic whorls, the lower two of which are longitudinally costate; remaining two spiral whorls costate and strongly striate spirally with lines of alternate strength; body whorl with ribs dying out submedially, slightly shouldered above, retral sinus very shallow; columella long, slightly deflected. The shell has a decided Fusoid appearance.

Locality.—ALABAMA: Matthews' Landing, Alabama river.

Type.—Lea Memorial collection, Ac. Nat. Sci., Phila.

Pleurotoma (*Drillia*) *quercollis*, Pl. 7, fig. 18.

Specific characterization.—Size and general form as indicated by the figure; whorls about 10; 1 and 2 smooth, 3 and 4 longitudinally costate; remaining spiral whorls marked by about 12 costæ, and by two strong spiral raised lines or carinæ on the larger part of the whorl and one subsutural line; body whorl marked like the spiral whorls, the costæ dying out subcentrally;

columella slightly curved; retral sinus very moderate.

This is a very small and beautifully sculptured species.

Locality.—ALABAMA: 1 mi. W. of Oak Hill P. O., Wilcox Co.

Type and specimen figured.—U. S. Nat. Museum collection.

The type is labelled simply Sta. 283, Wilcox Co., but doubtless came from the same locality as our University specimens.

OLIVELLA.

Olivella mediavia n. sp., Pl. 7, fig. 19.

Specific characterization.—General form and size as indicated by the figure; whorls about 7; the first extremely small, the second much larger, and the third still greater, producing a blunt appearance; remaining spiral whorls nearly or quite covered by the sutural callosity; body whorl smooth, but the direction of the lines of growth can be traced with a glass; growth lines slightly geniculated about three-fourths of the way from the suture to the anterior folds at a faint depression which produces a faint tooth on the margin of the outer lip; columella well twisted below where it is 7-8 striate; above on the columella there is often a large obtuse fold which marks a former position of the upper margin of the slit for the anterior canal.

Localities.—ALABAMA: 1 mi. W. of Oak Hill (Type); Matthews' Landing; ½ mi. W. of Graveyard hill; Black Bluff, Tombigbee river; ? 4 mi. below Black Bluff.

Type.—Paleontological Museum, Cornell Univ.

CARICELLA.

Caricella leana, Pl. 7, fig. 20.

Syn. *Scaphella* (*Caricella*) *leana* Dall, Trans. Wag. Fr. Inst. Sci., vol. iii, p. 86, pl. 6, fig. 9, 1890.

Dall's original description.—"Shell small, elongate-fusiform, of five or six whorls; nucleus small with a distinct spur or elevated point (which formation may conveniently be termed the *calcarella*) and composed of one whorl; suture closely appressed, the whorl somewhat constricted in front of it; the whole shell sculptured with small, subequal, close-set flattish spiral threads across which the incremental lines are hardly perceptible; aperture longer than the spire, narrow, with a faint recession at the suture (* * * * *) and a long, narrow,

straight canal; pillar with no siphonal fasciole, a thin glaze anteriorly, and four thin, sharp, well-elevated plaits of which the anterior is the least pronounced; canal not constricted off; outer lip simple. Lon. of shell 26.0; of aperture 18.0; max. lat. of shell 8.0 mm.

"Lower Lignitic series, Prairie Creek, Wilcox Co., Alabama, in the clays (No. 5) just above the Nautilus rock or Enclimatoceras limestone."

It is quite possible that Dall's specimen came from the clay immediately overlying the Nautilus rock, *i. e.*, bed 16 of our section p. 31. Ours, however, (pl. 7, fig. 20) came from Dale's Branch, bed 9; and from the confused state of Johnson's locality labels, it is quite possible that Dall's specimen came from bed 9. Certainly there is much misconception of the true relations of the Midway Eocene when it is stated that "The Nautilus rock is the first fossiliferous Eocene bed, and lies immediately over the Cretaceous Ripley beds," l. c., p. 86.

SCAPHELLA.

Scaphella showalteri, Pl. 7, fig. 21.

Syn. *Voluta showalteri* Ald., Bull. No. 1, Geol. Surv. Ala., 1886, p. 28, pl. 3, fig. 14.
Scaphella showalteri Dall, Trans. Wag. Fr. Inst. Sci., vol. iii, p. 80, 1890.

Aldrich's original description.—"Shell oval, oblong; whorls five; spire blunted; surface smooth and shining; lines of growth hardly perceptible; suture moderately impressed.

"Body whorl and next succeeding shouldered, bearing thereon numerous small tubercles; above the shoulder they are concave.

"Aperture two-thirds the length of the shell; columella four plaited—the upper one transverse, the middle ones oblique and larger. Outer lip smooth.

"*Locality.*—Matthews' Landing, Ala.

"This species is a true Volute, and belongs to the section *Vespertilio* Klein—Rare.

"Named in honor of Dr. E. R. Showalter, of Point Clear, Ala."

Localities of specimens in the Paleontological Museum of Cornell University.—ALABAMA: Matthews' Landing (figured specimen), Alabama river; Naheola Landing, Tombigbee river; Dale's Branch, near Oak Hill.

Scaphella sp., Pl. 7, fig. 23.

We have not good enough specimens of this species to warrant a specific description. It has seemed best to call attention to the existence of such a species so that others may find better or more determinable specimens.

Locality.—MISSISSIPPI: ½ mi. N. of Ripley. See p. 24, bed *e*.

Specimen figured.—Paleontological Museum, Cornell Univ.

VOLUTA.

Voluta lyroidea, Pl. 7, fig. 22.

Syn. *Volutilithes lyroidea* Ald., Geol. Surv. Ala., 1894, p. 245, pl. 13, fig. 7.

Aldrich's original description.—"Shell short, fusiform surface strongly ribbed with about eight plications ending rather abruptly at suture, giving the shell a shouldered appearance, no spiral lines observable, surface smooth, suture strongly impressed, spire missing in the type. The ribs are not continuous from one whorl to the other but alternate; body whorl large, ending in a short recurved canal. Aperture oblong.

"This species has a general resemblance to *Volutilithes rugatus* Con., but lacks the long canal, and has no spiral sculpture. The aperture is too imperfect to determine the exact generic position. It may turn out to be a *Lyria*.

"Length of part remaining 30 mm.; breadth 14 mm. Type in the National Museum."

Localities.—ALABAMA: Palmer's mill, see frontispiece; W. W. McConnico's plantation, 1½ mi. S. W. of Palmer's mill.

Voluta florencis n. sp., Pl. 8, figs. 6, a.

Specific characterization.—Size and general form as indicated by the figures; whorls unknown at apex, lower ones marked by about 7-9 plications, narrower than the interspaces, subacute, strongest at base of whorls; body whorl with 9 longitudinal plications, strong and subacute on the largest portion of the whorl but dying out rather rapidly below and reappearing above with some force near the suture; columella with four strong, nearly equal, oblique plaits, above which there are sometimes traces of three faint ones; anterior canal strongly deflected as in *V. muricina* Lam.; substance of the shell very thick.

The columellar and canal features are determined by means of

the cast shown in fig. 6, a. A gutta-percha mould of the same individual is shown by fig. 6. The plaits shown in the latter figure are restored from the cast, fig. 6, a. As we have but few specimens it is not possible to give the apical features, but in so much as the plaits, the exterior marking and the absence of liræ on the interior of the outer lip are all indicative of this genus we think it can be placed here with little doubt.

Localities.—ALABAMA: Light yellowish limestone in a R. R. cut, 1⅓ mi. N. E. of Clayton.
GEORGIA: Base of Midway limestone, Chattahoochee river, about 3 mi. S. of the mouth of Pataula creek.

Type.—Paleontological Museum, Cornell Univ. Type from 1⅓ mi. N. E. of Clayton.

VOLUTILITHES.

Volutilithes rugatus, Pl. 8, fig. 1.

Syn. *V. rugatus* Con., Jr. Ac. Nat. Sci., Phila., vol. iv, 1860, p. 292, pl. 47, fig. 32.

Conrad's original description.– "Fusiform; spire somewhat elevated; volutions eight, convex, with minute, reticulated lines, the revolving lines microscopic; larger revolving lines prominent; ribs on the body whorl irregular, wanting near the base; an impressed line revolves below the suture, giving that part of the shell between this line and the suture an obscurely or obtusely carinated character; revolving lines on the body whorl distinct, a deposit on the inner lip; columella with three approximate, obtuse folds, the middle one obsolete; aperture narrow.
"Length 2 inches."
Conrad omits to mention the fact that the humeral region of the costæ is often very much developed, showing a tendency to become bluntly spinous.

Localities.—TEXAS: A few fragments seemingly of this species.
ALABAMA: Black Bluff, and 4 miles below, Tombigbee river; Matthews' Landing; Dale's Branch; 1 mi. W. of Oak Hill P. O.

Volutilithes rugatus var. *saffordi*, Pl. 8, fig. 2.

Syn. *Fasciolaria saffordi* Gabb, Jr. Ac. Nat. Sci., Phila., vol. iv, 1860, p. 390, pl. 68, fig. 6.

Gabb's original description.—"Fusiform, spire? (broken in all

the specimens); suture distinct; mouth linear, columella slightly recurved and with three small oblique folds, inner lip slightly thickened at the upper part; surface marked by longitudinal ribs, (about eleven on the body whorl), crossed by numerous revolving lines.

"*Dimensions.*—Length of the body whorl of the smallest, but most perfect specimens, .6 in.; width of ditto, .4 in.; length of mouth, .55 in."

The locality from which Gabb cites this species is "Hardeman Co., Tenn." and its geological horizon, "Ripley Group."

This is characterized by a strong subsutural row of short tubercles located at the upper termination of the well defined ribs. Below this row the body whorl has a rather prominent shoulder; on the shoulder and below there are three rather strong rows of tubercles, while the revolving lines below carry only slightly thickened nodes as they cross the ribs. The columellar plaits are normally: one strong one, with a weaker one above; between these two there is often a small one, and there are several smaller ones above the weak one just mentioned.

Localities.—TENNESSEE: Hannah's, 1¾ mi. N. E. of Crainesville, bed *b;* Middleton, and two miles to the S. S. E. (Type fig'd).

ALABAMA: Naheola; Palmer's mill, bed 21, sect. p. 31; ½ mi. W. of Graveyard hill; 1 mi. N. of Midway.

GEORGIA: ? Ft. Gaines, Uppermost layer of Midway.

Volutilithes limopsis, Pl. 8, fig. 3.

Syn. *V. limopsis* Con., Jr. Ac. Nat. Sci., Phila., vol. iv, 1860, p. 292, pl. 47, fig. 24.

Conrad's original description.—"Subfusiform; volutions seven; body whorl longitudinally ribbed; ribs angular, acutely tubercular on the upper part; revolving lines prominent, acute, more salient where they cross the ribs, about twenty-seven in number; whorls of spire slightly convex, five series of tubercles on last volution; aperture narrow-elliptical; inner lip with a thin, wide deposit; columella with three plaits, the superior one obsolete or very small.

"Length 1⅜ inches. Diameter ⅝ inch.

"A beautiful species resembling *V. crenulata* Lam., or more nearly *V. ambigua*, but it has a more fusiform shape than either, a norrower aperture and dissimilar folds on the columella."

Localities.—TEXAS: Elgin, Bastrop Co.
ALABAMA: Matthews' Landing, 1 mi. W. of Oak Hill.

Type.—Ac. Nat. Sci., Phila.

Volutilithes quercollis n. sp., Pl. 8, fig. 4.

Specific characterization.—Size and general form as indicated by the figure; whorls 7; 1 and 2 smooth; the remainder with somewhat arcuate costations; lines of growth extremely minute, longitudinal, *i. e.*, not oblique, hence occasionally crossing the oblique costæ; sunken spiral lines very faint just below the suture, then occurring in pairs over the rest of the whorl; between each pair on each costa a nodose projection is formed giving the shell a rough appearance; columella with one, and perhaps two, rather strong folds and traces of smaller ones; costation evanescent on lower part of body whorl.

Locality.—ALABAMA: Dale's Branch, near Oak Hill.

Type.—Paleontological Museum, Cornell Univ.

LYRIA.

Lyria wilcoxiana, Pl. 8, fig. 5.

Syn. *L. wilcoxiana* Ald., Geol. Surv. Ala., 1894, p. 243, pl. 12, fig. 4.

Aldrich's original description.—"Shell rounded fusiform, whorls four, spire blunt, first three whorls smooth, body whorl transversely ribbed, the ribs rather sharp with concave spaces; no spiral sculpture shown; suture distinct, not deeply impressed; body whorl long terminating in a canal, which is missing in specimen figured; aperture long and narrow, inner lip showing a few plications, but the aperture is filled in so that the lips are almost completely hidden.

"Specimen is partially silicified. Prof. Dall refers to this species, but without describing it in Trans. Wag. Fr. Inst. Sci., vol. iii, p. 69. Type in National Museum."

According to Mr. Aldrich's notes elsewhere in his article, the locality for this species is on or near McConnico's plantation, Wilcox Co., Ala.

A specimen in our collection from 1 mi. N. of Midway is probably of this species, but has a slightly higher spire and so far as can be determined has no columellar plaits.

MITRA.

Mitra subpontis n. sp., Pl. 8, figs. 7, a.

Specific characterization.—General form and size as indicated by the figures; whorls about 7; apex acute; spiral whorls smooth, slightly inflated; suture distinct but not deep; body whorl with spiral striation at base and generally with one varix; outer lip thickened; columella with four strong subequal folds below and two or three smaller ones above.

The folds on the columella of this species resemble those of some groups of Volutes, but the general form is that of the *Mitræ*, and the apex is acute. The varix is remarkable for this genus or allied genera.

Localities.—GEORGIA: Uppermost beds of the Midway horizon as represented on the Chattahoochee at Ft. Gaines. Specimens are not rare, though by no means abundant.

Type.—Paleontological Museum, Cornell Univ.

Mitra hatchetigbeensis?, Pl. 8, fig. 8.

Syn. *M. hatchetigbeensis* Ald., Bull. No. 1, Geol. Surv. Ala., 1886, p. 28, pl. 6, fig. 3.

This form has considerable resemblance to *M. hatchetigbeensis* but so far as observed has but two plaits on the columella instead of three. The specimen herewith figured is from Black Bluff, Tombigbee river, Sta. 297, of U. S. Nat. Mus. Record. Less perfect specimens were collected from the same locality by Hubbard and Harris, 1895.

FUSUS.

Fusus quercollis n. sp., Pl. 8, fig. 9.

Specific characterization.—Size and general form as indicated by the figure; whorls, probably about 10, strongly carinated, smooth above, with about twelve tooth-like, vertically compressed tubercles on the carina; below the same a short distance a strong spiral, raised line, still lower, a second somewhat fainter and below this a third corresponding to the suture of the next whorl. On the body whorl the first spiral line below the suture is also fairly strong but the succeeding spirals are fainter and disappear entirely on the anterior canal, which is extremely long, straight and slender. The lines of growth are evident on specimens of this species but they are not crossed by fine spirals, hence the

shell has a polished appearance above the carina and between the strong spiral lines.

Localities.—MISSISSIPPI: ½ mi. N. of Ripley.
ALABAMA: 1 mi. W. of Oak Hill P. O., Wilcox Co.

Type.—Department of Paleontology, Cornell Univ.

Fusus hubbardanus n. sp., Pl. 8, figs. 10, 11.

Specific characterization.—General form and size as indicated by the figures; whorls at least 10; ornamented by (*a*) spiral lirations, about five very strong ones below the shoulder, with an equal number of fainter alternate striæ, and five or six faint ones above, growing fainter as they approach the suture; (*b*) by obtuse nodular costations, 14 on the penultimate whorl, strong at the shoulder but dying out rapidly above, less rapidly below; lines of growth fine but well marked, especially on the body whorl. On the last mentioned whorl the nodular costæ are faint and confined to the humeral angle; the spiral lirations below, about 10 in number, are strong; columella long, straight. Suture more or less filled by a revolving ridge.

Localities.—MISSISSIPPI: Bed *e*, ½ mi. N. of Ripley, see p. 23.
ALABAMA: ? Palmer's mill, Wilcox Co.

Type.—Paleontological Museum, Cornell Univ.

Fusus meyeri var., Pl. 8, fig. 12.

Syn. *F. meyeri* Ald., Bull. No. 1, Geol. Surv. Ala., p. 21, pl. 3, fig. 12.

Aldrich's original description.—"Shell elongate fusiform; spire slender, acute; whorls fourteen; surface of the spire and body whorl with seven longitudinal broadly rounded folds, which are spirally arranged, crossed by raised rounded striæ, generally seven in number, rather distant, the central one making a sharp carina on the center of each whorl, with erect longitudinal tubercles at the intersections; spaces between striæ showing only lines of growth; canal very long, spirally striated with alternate raised lines; lines of growth very numerous and almost obsolete; mouth small, oblong-ovate; outer lip incurved, smooth.

"*Locality.*—Lower bed, Woods' Bluff, Ala.; Matthews' Landing, Ala.

"The figured type retains four embryonic whorls; three are smooth, the fourth longitudinally striate. The Matthews' Landing form is smaller and even more beautiful. One specimen has the ribs obsolete on the upper half of the whorls and the periphery armed with erect longitudinal spines, giving the shell a

very strongly carinate form. *Fusus mississippiensis*, Con., from Vicksburg, resembles this form, but this is more carinate, with longer canal and spire; the latter species has many more revolving lines, and the outer lip is striate internally. Named in honor of Dr. Otto Meyer."

The specimens from the Matthews' Landing horizon are very different from those from Wood's Bluff. The body whorls are not so widely different as are the spires. In the Matthews' Landing—Oak Hill type there are as high as 18 costæ on some of the whorls. They are sharp, well defined, direct from the suture to the sharp carina. In the Wood's Bluff forms the costæ on the spire number the same as on the body whorl, about 7 or 8; they are also of the same form. Again, in the Wood's Bluff forms there is no tendency for the third line below the keel to become very prominent as it does in the Matthews' Landing specimens. It is possible the two may be united by intermediate forms, but there is reason certainly for doubting it. The Wood's Bluff forms resemble closely *F. unicarinatus*.

Type.—Collection of T. H. Aldrich.

Specimen figured.—1 mi. W. of Oak Hill, Ala. The same variety is also found in Dale's Branch.

Fusus ostrarupis, Pl. 8, fig. 13.

Syn. *F. ostrarupis*—Proc. Ac. Nat. Sci., Phila., 1895, p. 72, pl. 7, fig. 3.

Harris' original description.—"General form as figured; whorls 8; 1 and 2 smooth and polished, 3 sometimes polished, with long, undulating costæ, 4, 5, 6, 7 evenly striate spirally, and with seven or eight longitudinal costæ; costæ decreasing in size, about or just below the suture where a slightly depressed zone occurs; body whorl with eight or ten costæ somewhat variable in size, subsutural zone much compressed, spiral striæ moderately even but slightly strongest on the largest part of the whorl; labrum strongly striate within; columella recurving; umbilicus rudimentary.

"*Locality.*—Smiley's Bluff, Brazos river, 2 miles above the mouth of Pond creek, Milam Co., Tex. Oyster Bluff of Penrose's Report.

"*Geological horizon.*—Midway Eocene.

"*Type.*—Texas State Museum."

Fusus tortilis, Pl. 8, fig. 14.

Syn. *Fusus tortilis* Whitf., Amer. Jr. Conch, 1, 1865, p. 260, pl. 27, fig. 5.

Whitfield's original description.—"Shell elongate fusiform; spire slender, especially in the upper part, consisting of seven or eight subangular volutions, each marked by six strong longitudinal folds or varices, which are spirally arranged, those of one volution being a little behind the corresponding one of the preceding volution, the whole making about one-fourth of a turn in the length of spire; canal long and straight, making with the narrow ovate aperture, rather more than one-half of the entire length; surface marked by somewhat alternating revolving lines, strongest on the largest part of each volution.

"*Dimensions.*—Length 1.75 inches, transverse diameter .7 inch.

"*Locality.*—Nine miles below Prairie Bluff, Ala."

Type.—Hall collection.

Localities.—MISSISSIPPI: 1½ mi. E. of Ripley (probably of this species).
ALABAMA: Matthews' Landing; 1 mi. W. of Oak Hill; Dale's Branch.
GEORGIA: Uppermost layer of Midway limestone at Ft. Gaines.

Fusus mohri, Pl. 8, fig. 15.

Syn. *F.? mohri* Ald., Bull. Am. Pal., No. 2, 1895, p. 12, pl. 3, fig. 6.

Aldrich's original description.—"Shell broadly ovate, apex pointed; whorls ten, the first five very small, smooth, the sixth partially so passing into the adult stage; adult whorls with six strongly developed transverse ribs which are angular at the periphery; spiral sculpture coarse, more so at the junction with the ribs, making each one to terminate in a rounded and beaded projection broader at the point than elsewhere; columella straight, slightly thickened at the lower half of the aperture; canal straight.

"*Locality.*—Matthews' Landing, Ala."

Fragments indicate that this species often attains a length of four or five inches. In adults the peristome has a broad sinus at the carina and the lip is there slightly reflected.

Localities.—ALABAMA: Naheola, Tombigbee river; Matthews' Landing; 1 mi. W. of Oak Hill P. O.; Dale's Branch.

Type.—Aldrich's collection.

EXILIA.

Exilia pergracilis, Pl. 9, fig. 1.

Syn. *E. pergracilis* Con., Jr. Ac. Nat. Sci., Phila., vol. iv, 1860, p. 291, pl. 46, fig. 34.

Conrad's original description.—"Narrow-fusiform; volutions twelve, convex, with slightly curved, numerous, narrow ribs, and fine closely-arranged revolving lines; spire rather longer than aperture, first two whorls smooth; beak perfectly straight, minutely striated to the extremity.

"*Locality.*—Alabama. Dr. Showalter."

This species sometimes attains a length of 1½ inches or even more, but generally it is not over 1 inch long,

Localities.—MISSISSIPPI: ½ mi. N. of Ripley.
ALABAMA: Matthews' Landing; 1 mi. W. of Oak Hill P. O.; Dale's Branch.

Type.—Phila. Ac. Nat. Sci.

PYROPSIS.

Pyropsis perula, Pl. 9, fig. 2.

Syn. *Pyropsis perula* Ald., Bull. No. 1, Geol. Surv. Ala., 1886, p. 25, pl. 3, fig. 4.

Aldrich's original description.—"Shell depressed above, spinous; whorls seven; spire flat, showing only the upper part of the whorls; suture partially concealed by the spines of the next succeeding whorl overlapping.

"Surface covered with strong, transverse, raised, cordlike lines, which are armed with short, erect spines on the canal, becoming obsolete at its base. Spines erect, closed, flaring upward and circling the periphery of the body whorl, the one nearest the aperture being the largest. Aperture ovate; outer lip cut by the transverse lines, smooth within; labium strongly reflected, smooth, suddenly expanding at the anterior end of aperture; callus becomes thick in old specimens; canal long and narrow.

"*Locality.*—Wood's Bluff, Ala., in lower bed; also Matthews' Landing, Ala.

"The largest specimen, if perfect, would be (2″) two inches broad and over (4″) four inches long."

Localities.—ALABAMA: Dale's Branch; 1 mi. W. of Oak Hill; Matthews' Landing.

The specimen figured herewith is very small and imperfect

but it suffices to show that the species is present in the Matthews' Landing horizon as far east as Dale's Branch, near Oak Hill P. O. A very large, perfect specimen from Wood's Bluff is now being figured by Dr. McConnell of Washington.

Type.—Aldrich's collection.

Specimen figured.—Dale's Branch.

STREPSIDURA.

Strepsidura heilprini, Pl. 9, fig. 3.

Syn. *S. heilprini* Ald., Bull. Am. Pal., No. 2, 1895, p. 12, pl. 4, fig. 1.

Aldrich's original description.—"Shell short, stout; whorls nine, first four smooth, embryonic, the fifth costate, the others with about six profoundly raised and rounded transverse ribs; surface reticulated, apex pointed; outer lip striated within; columella twisted, bearing at the narrow part far within a single fold; canal extremely twisted and turned upward at base.

"*Locality.*—Matthews' Landing, Ala."

Type.—T. H. Aldrich's collection.

Our collection includes specimens from Matthews' Landing and 1 mile west of Oak Hill P. O.

Specimens of a different, though somewhat related species were collected at Black Bluff, on the Tombigbee.

Strepsidura? mediavia n. sp., Pl. 8, figs. 16, a, 17.

Specific characterization.—Size and general form as indicated by the figures; whorls probably about 6; spiral whorls ornamented by about 8 basal nodular ribs and about an equal number of revolving lines; body whorl showing 9 or 10 rounded ribs, strongest on the carina, dying out above and becoming faint below; spiral striation above the carina, distinct but much finer than that below; lines of growth fine, swinging backward from the suture to the carina, thence curving slightly forward again and finally recurving, as in *Levifusus;* columella with a *Fulgur*-like angle upon which are located one strong, very sharp, basal plait and one less distinct, above. In old, large specimens the columella is large and umbilicate.

The general form of this species with its long anterior canal not sharply reflected, and the presence of an umbilicus render the reference of this species to *Strepsidura* not certain; yet unless a new genus is proposed we are at a loss to know where it can better be placed.

Localictes.—ALABAMA: On McConnico's plantation, 1½ mi. S. W. of Palmer's mill; roadside, 1 mi. S. of Palmer's mill.

Type.—Paleontological Museum, Cornell Univ.

LEUCOZONIA.

Leucozonia biplicata, Pl. 9, fig. 4.

Syn. *L. biplicata* Ald., Bull. No. 1, Geol. Surv. Ala., 1886, p. 23, pl. 5, fig. 15.

Aldrich's original description.—"Shell broadly fusiform; whorls six—nucleus composed of two smooth whorls, those remaining covered with revolving, somewhat alternating raised lines and strong longitudinal ribs, which give the shell an angular appearance. Outer lip sinuate, thickened internally, finely crenated; columella bearing two erect, strong folds, the posterior one nearly twice as large as the other, below these folds nearly straight.

"Aperture terminating in a short, open canal. A small umbilicus nearly covered by callus.

"*Locality.*—Matthews' Landing, Ala."

Not having any good specimen of this species we have copied Aldrich's figure.

MAZZALINA.

Mazzalina impressa, Pl. 9, figs. 5, 6.

Syn. *Neptunea impressa* Gabb, Jr. Ac. Nat. Sci., Phila., vol. iv, p. 389, pl. 68, fig. 5.

Gabb's original description.—"Fusiform, whorls six, rounded; spire sharp, but not very high; mouth ovate, canal moderately long, outer lip simple, inner lip coated with a somewhat heavy layer of enamel, a very small sinus between the two lips posteriorly, not an emargination but rather a continuation of the suture, lined with enamel; surface in some specimens nearly smooth, in others closely marked by fine impressed, revolving lines.

"*Dimensions.*—Length .8 in., width of body whorl .5 in., length of mouth .55 in.

"*Locality.*—Hardeman Co., Tenn. Ripley Group."

We herewith figure two of Gabb's types (Safford's collection). They are from a dark, bluish gray, fine, sandy clay, 2 miles south-southeast of Middleton, Tenn.

Mazzalina impressa var. *orientalis*. Pl. 9, fig. 7.

Varietal features.—Whorls more strongly sculptured than those of typical *impressa;* spiral whorls becoming quite nodular towards the apex.

Locality.—GEORGIA: Base of the Midway, Chattahoochee river.

Types.—Paleontological Museum, Cornell Univ.

LEVIFUSUS.

Levifusus pagoda var., Pl. 9, fig. 8.

Syn. *Pleurotoma? pagoda* Heilprin, Proc. U. S. Nat. Mus., 1880, p. 149, pl. , fig. 1.
Fusus pagodeformis Hp., Proc. Ac. Nat. Sci., Phila., 1880, p. 375.
Fusus pagodæformis Hp., *ibid.*, 1890, p. 395.

Heilprin's original description.—"Ventricose; whorls about nine, the body whorl nodulated on the most convex portion (nearly central), the nodulations consisting of a single series of sharp, obtusely pointed, and flattened spines or nodes, which frequently appear double by the crossing of an impressed line over their basal portion; upper volutions with a similar series of nodes almost immediately above the sutural line, and gradually dwindling off into a crenulation, upper surface of the whorls concave, faintly striated, the sinual rugæ indicating but a faint sinus; lower surface with numerous well developed revolving lines, which show a tendency to alternate. Aperture exceeding the spire in length, considerably contracted at about its center.

"Length, 1½ inch.

"Eocene of Alabama."

The generic position of this species has for some time been a matter of perplexity to the writer. Now, however, its generic if not specific identity with Aldrich's *Levifusus suteri* can be proven by our ample collection of *pagoda*-like forms. The Matthews' Landing specimens often have somewhat higher spires than those do from Oak Hill; one of the latter is shown by our figure. At Bell's Landing, the two forms, *suteri* and *pagoda*, both varying somewhat from the Matthews' Landing specimens, are found in the same bed. The Wood's Bluff specimens when young have a decided *Surcula*-like aspect owing to the height of their spires, but when adult the large size of the body whorl gives them a still greater likeness to *Fulgur*-like genera. The many intermediate forms between *suteri* and *pagoda* can be more properly discussed in our next year's work, and hence the matter will be

Localictes.—ALABAMA: On McConnico's plantation, 1½ mi. S. W. of Palmer's mill; roadside, 1 mi. S. of Palmer's mill.

Type.—Paleontological Museum, Cornell Univ.

LEUCOZONIA.

Leucozonia biplicata, Pl. 9, fig. 4.

Syn. *L. biplicata* Ald., Bull. No. 1, Geol. Surv. Ala., 1886, p. 23, pl. 5, fig. 15.

Aldrich's original description.—"Shell broadly fusiform; whorls six—nucleus composed of two smooth whorls, those remaining covered with revolving, somewhat alternating raised lines and strong longitudinal ribs, which give the shell an angular appearance. Outer lip sinuate, thickened internally, finely crenated; columella bearing two erect, strong folds, the posterior one nearly twice as large as the other, below these folds nearly straight.

"Aperture terminating in a short, open canal. A small umbilicus nearly covered by callus.

"*Locality.*—Matthews' Landing, Ala."

Not having any good specimen of this species we have copied Aldrich's figure.

MAZZALINA.

Mazzalina impressa, Pl. 9, figs. 5, 6.

Syn. *Neptunea impressa* Gabb, Jr. Ac. Nat. Sci., Phila., vol. iv, p. 389, pl. 68, fig. 5.

Gabb's original description.—"Fusiform, whorls six, rounded; spire sharp, but not very high; mouth ovate, canal moderately long, outer lip simple, inner lip coated with a somewhat heavy layer of enamel, a very small sinus between the two lips posteriorly, not an emargination but rather a continuation of the suture, lined with enamel; surface in some specimens nearly smooth, in others closely marked by fine impressed, revolving lines.

"*Dimensions.*—Length .8 in., width of body whorl .5 in., length of mouth .55 in.

"*Locality.*—Hardeman Co., Tenn. Ripley Group."

We herewith figure two of Gabb's types (Safford's collection). They are from a dark, bluish gray, fine, sandy clay, 2 miles south-southeast of Middleton, Tenn.

Mazzalina impressa var. *orientalis*. Pl. 9, fig. 7.

Varietal features.—Whorls more strongly sculptured than those of typical *impressa;* spiral whorls becoming quite nodular towards the apex.

Locality.—GEORGIA: Base of the Midway, Chattahoochee river.

Types.—Paleontological Museum, Cornell Univ.

LEVIFUSUS.

Levifusus pagoda var., Pl. 9, fig. 8.

Syn. *Pleurotoma? pagoda* Heilprin, Proc. U. S. Nat. Mus., 1880, p. 149, pl. , fig. 1.
Fusus pagodeformis Hp., Proc. Ac. Nat. Sci., Phila., 1880, p. 375.
Fusus pagodæformis Hp., *ibid.*, 1890, p. 395.

Heilprin's original description.—"Ventricose; whorls about nine, the body whorl nodulated on the most convex portion (nearly central), the nodulations consisting of a single series of sharp, obtusely pointed, and flattened spines or nodes, which frequently appear double by the crossing of an impressed line over their basal portion; upper volutions with a similar series of nodes almost immediately above the sutural line, and gradually dwindling off into a crenulation, upper surface of the whorls concave, faintly striated, the sinual rugæ indicating but a faint sinus; lower surface with numerous well developed revolving lines, which show a tendency to alternate. Aperture exceeding the spire in length, considerably contracted at about its center.

"Length, 1½ inch.

"Eocene of Alabama."

The generic position of this species has for some time been a matter of perplexity to the writer. Now, however, its generic if not specific identity with Aldrich's *Levifusus suteri* can be proven by our ample collection of *pagoda*-like forms. The Matthews' Landing specimens often have somewhat higher spires than those do from Oak Hill; one of the latter is shown by our figure. At Bell's Landing, the two forms, *suteri* and *pagoda*, both varying somewhat from the Matthews' Landing specimens, are found in the same bed. The Wood's Bluff specimens when young have a decided *Surcula*-like aspect owing to the height of their spires, but when adult the large size of the body whorl gives them a still greater likeness to *Fulgur*-like genera. The many intermediate forms between *suteri* and *pagoda* can be more properly discussed in our next year's work, and hence the matter will be

passed over for the present with only this slight notice.

Since our *L. branneri* of the Jackson group is extremely close to *Fulgur*, it is interesting to note how the last mentioned genus may have been derived from *Pleurotoma*. The successive steps would be *Pleurotoma*, *Surcula*, *Levifusus* (*pagoda*-like forms), *Levifusus* (*suteri*-like forms), *Levifusus* (*trabeatus*-like forms), *Levifusus branneri*, *F. echinatum*. Another branch leaves the *pagoda*-like prototype and gives off forms like *L. dalei* and *L. blakei* with but one spinous strong carination.

After writing the above we notice that Dall has called attention to the fact that *Levifusus* is a precursor of *Fulgur*. In this we agree most heartily; in fact our writings of several years ago, but published only last year, (Proc. Ac. Nat. Sci., Phila., 1895, p. 70), plainly state the same fact. We cannot, however, agree with Dall when he ranks *Bulbifusus* as likewise one of the progenitors of *Fulgur*. We have already shown that *Bulbifusus* and *Mazzalina* are synonyms (Ann'l Rep't Geol. Surv. Ark., 1892, p. 165), and hence are Fasciolarioid and not Fulguroid.

The perculiar reversion of many of the *Levifusi* towards *Pleurotoma* is worthy of special notice. Heilprin described *L. pagoda* as a *Pleurotoma;* in the U. S. Nat. Museum we frequently classed it as "*Pleurotomella.*" Specimems of a form (*L. trabeatoides*) from Texas, Louisiana and Arkansas, both Dall and myself, before carefully studying them, were inclined to place among the *Pleurotomæ*. Even in the Miocene of St. Mary's, Md., there are Fulgurs with a *Levifusus* or *Surcula*-like aspect. See *F. tuberculatum* and *F. fusiforme*.

Localities (Midway).—ALABAMA: Matthews' Landing; 1 mi. W. of Oak Hill P. O.

Type.—U. S. National Museum.

Levifusus suteri, Pl. 9, fig. 9.

Syn. *Levifusus suteri* Ald., Bull. Am. Pal., No. 2, 1895, p. 11, pl. 3, fig. 4.

Aldrich's original description.—"Shell oblong-ovate, whorls seven, the first three smooth, next nodular and angulated. The periphery of each whorl marked by a double spiral line or band carrying nodes where crossed by longitudinal plications; upper part of whorls looking down on same shows a spiral line inside of the peripheral border following the sinuosities of the same; periphery of body whorl spinous and beaded, followed by a broad concave space below, then a second spiral ring, followed by a third space and ring; spiral lines cover the canal; the third spiral ring extending within the aperture; outer lip smooth, aperture

quadrate above with a narrowing canal below; columella smooth, curved; canal slightly twisted, umbilicus rudimentary.

"*Locality*.—Matthews' Landing, Ala."

Specimen figured.—1 mi. W. of Oak Hill, Wilcox Co., Ala.

Levifusus trabeatus var., Pl. 9, fig. 10.

Syn. *Fusus trabeatus* Con., Foss. Sh. Tert. Form., Sept., 1833, p. 29; 2d ed., p. 53, pl. 18, fig. 1.
F. bicarinatus Lea, Cont. to Geol., Dec., 1833, p. 146, pl. 5, fig. 147.
Levifusus trabeatus var., Ald., Bull. Am. Pal., No. 2, p. 10, pl. 4, fig. 6.

Conrad's original description.—"Shell subfusiform, ventricose, with revolving elevated striæ at the base and more obscure ones on the spire: body whorl with two distinct rows of tubercles, humeral one continued on the spire. Length 1½ inches.

"*Locality*.—Claiborne, Ala.

"Cab. Acad. N. S."

This, if *trabeatus* at all, is a strongly spinous variety that lacks all traces of the third carina which generally characterizes the genus; the specimen herewith figured is the same specimen shown by fig. 6, pl. 4, of Bull. No. 2. It is from Matthews' Landing and belongs to T. H. Aldrich. A fragment of the same is in our collection from Dale's Branch.

A specimen in Dr. Safford's collection from Middleton, Hardeman Co., Tenn., is very strongly bicarinate but the tubercles are not so large nor so far apart. A small specimen is in our collection from bed *e*, ½ mi. N. of Ripley, showing a great number of denticulations on the upper carina while the lower is smooth.

Levifusus hubbardi n. sp., Pl. 9, fig. 11.

Specific characterization.—General form somewhat more slender than shown in the figure owing to the compressed and broadened condition of the cast from which the figure was drawn; whorls about 7 or 8; spiral whorls marked by (*a*) a prominent median carina bearing a number of slightly flattened spines, (*b*) a more or less prominent spiral line midway between the carina and the suture below; suture with a spiral line; body whorl strongly bicarinate, each carina bearing about 20 slightly flattened spines which affect the surface but little above or below their respective carinas; somewhat below the lower strong carina there is a third, consisting of a narrow, raised, strong line which likewise bears about 20 small spines; still below this faint carina there is a strong revolving line; outer lip angular at points where the carinas

inpinge upon it, sharp-edged, thickened within and there lirate; anterior canal somewhat reflexed.

This species differs from all species of this genus heretofore described, by its extremely high spire, the revolving line below the carina of the spiral whorls, and in the structure of the lowest carina on the body whorl, *i. e.*, it is narrow, sharply defined and spine bearing, while in all other known species it is broad, smooth and indefinite. Were the specimen figured not flattened by pressure it would appear much more slender, or *Fusus*-like.

Locality.—MISSISSIPPI: ½ mi. N. of Ripley.

Type.—Paleontological Museum, Cornell Univ.

Levifusus dalei n. sp., Pl. 9, fig. 12.

Specific characterization.—Size and general form as indicated by the figure; whorls about 6; 1 and 2 smooth, 3, 4, 5 with a denticulate carina below the middle of each whorl; body whorl with a humeral carina bearing about 20 compressed denticulations, above with lines of growth prominent and showing a broad yet well defined retral sinus, below with lines of growth fine but visible and distinct; spiral striæ above the carina extremely fine and even, below the same, stronger and alternating in size; pillar long and straight with a thin coating; labrum smooth within.

Fragments of larger specimens show that the carinal spines become long yet very much compressed vertically, with age; the spiral lines below the carina become very pronounced.

The general form of older specimens approaches *Fusus quinquespinus* Dall, though of course there are more than five spines.

Locality.—ALABAMA: Dale's Branch, near Oak Hill P. O., Wilcox Co.

Type.—Paleontological Museum, Cornell Univ.

FULGUR.

Fulgur? dallianum n. sp., Pl. 9, fig. 13.

Specific characterization.—Size and general form as indicated by the figure; spire low, whorls about 5, the humeral angle of each corresponding to the suture or nearly so, faintly tubercular; body whorl bicarinate, the upper carination ornamented with vertically compressed, not prominent, tubercles, the lower carination less prominent and not ornamented; inner lip somewhat calloused and covering the inner margin of the columella and the inner lower portion of the adjacent whorl; lines of growth when leaving the suture not directed radially outwards but bent

back at an angle of perhaps 30° from a true radius; in approaching the carina, however, they curve slightly forward, having passed the same they pass nearly vertically downwards though inclining slighly forwards; at the lower carina they are deflected slightly backwards; spiral striation very faint in the specimen figured, though doubtless fine, even, and everywhere present on well preserved specimens.

Locality.—This specimen (the only one known) belongs to the collection of the U. S. Nat. Museum and is marked "264a, Wilcox Co., Ala., L. C. Johnson," collector. The nature of the matrix in which this specimen was embedded renders it safe to say that it came from bed 18, sect. p. 31, a mile or two south or southwest of Palmer's mill.

NEPTUNEA.

Neptunea constricta, Pl. 9, fig. 14.

Syn. *N. constricta* Ald., Bull. No. 1, Geol. Surv. Ala., 1886, p. 24, pl. 5, fig. 13.
N. matthewensis Ald., *idem.*, p. 59.

Aldrich's original description.—"Shell broadly fusiform, whorls eight, spire high; suture distinct, whorls concave and compressed just below the suture; covered at this point with fine transverse lines, remaining space smooth. Body whorl large, smooth below the the above-mentioned sutural area, narrowed below into a short, stout canal which is marked by fine revolving lines. Aperture about two-thirds the length of the shell; outer lip sharp, thickened and crenulate within; inner lip concave above, straight below; callus not heavy.

"*Locality.*—Matthews' Landing, Ala."

Our specimens from this locality are fragmentary, hence I have copied Aldrich's figure. An imperfect cast from bed *b* at Hannah's, near Crainesville, Tenn., is quite probably of this species.

Several of our specimens indicate a size considerably greater than the figure.

LEVIBUCCINUM.

Levibuccinum lineatum, Pl. 9, fig. 15.

Syn. *L. lineatum* Heilp., Proc. Ac. Nat. Sci., Phila., 1880, p. 371, pl. 20, fig. 5.
L. lineatum Ald., Geol. Surv. Ala., Bull. 1, 1886, p. 59.

Heilprin's original description.—"Shell fusiform, of about seven

inpinge upon it, sharp-edged, thickened within and there lirate; anterior canal somewhat reflexed.

This species differs from all species of this genus heretofore described, by its extremely high spire, the revolving line below the carina of the spiral whorls, and in the structure of the lowest carina on the body whorl, *i. e.*, it is narrow, sharply defined and spine bearing, while in all other known species it is broad, smooth and indefinite. Were the specimen figured not flattened by pressure it would appear much more slender, or *Fusus*-like.

Locality.—MISSISSIPPI: ½ mi. N. of Ripley.

Type.—Paleontological Museum, Cornell Univ.

Levifusus dalei n. sp., Pl. 9, fig. 12.

Specific characterization.—Size and general form as indicated by the figure; whorls about 6; 1 and 2 smooth, 3, 4, 5 with a denticulate carina below the middle of each whorl; body whorl with a humeral carina bearing about 20 compressed denticulations, above with lines of growth prominent and showing a broad yet well defined retral sinus, below with lines of growth fine but visible and distinct; spiral striæ above the carina extremely fine and even, below the same, stronger and alternating in size; pillar long and straight with a thin coating; labrum smooth within.

Fragments of larger specimens show that the carinal spines become long yet very much compressed vertically, with age; the spiral lines below the carina become very pronounced.

The general form of older specimens approaches *Fusus quinquespinus* Dall, though of course there are more than five spines.

Locality.—ALABAMA: Dale's Branch, near Oak Hill P. O., Wilcox Co.

Type.—Paleontological Museum, Cornell Univ.

FULGUR.

Fulgur? dallianum n. sp., Pl. 9, fig. 13.

Specific characterization.—Size and general form as indicated by the figure; spire low, whorls about 5, the humeral angle of each corresponding to the suture or nearly so, faintly tubercular; body whorl bicarinate, the upper carination ornamented with vertically compressed, not prominent, tubercles, the lower carination less prominent and not ornamented; inner lip somewhat calloused and covering the inner margin of the columella and the inner lower portion of the adjacent whorl; lines of growth when leaving the suture not directed radially outwards but bent

back at an angle of perhaps 30° from a true radius; in approaching the carina, however, they curve slightly forward, having passed the same they pass nearly vertically downwards though inclining slighly forwards; at the lower carina they are deflected slightly backwards; spiral striation very faint in the specimen figured, though doubtless fine, even, and everywhere present on well preserved specimens.

Locality.—This specimen (the only one known) belongs to the collection of the U. S. Nat. Museum and is marked "264a, Wilcox Co., Ala., L. C. Johnson," collector. The nature of the matrix in which this specimen was embedded renders it safe to say that it came from bed 18, sect. p. 31, a mile or two south or southwest of Palmer's mill.

NEPTUNEA.

Neptunea constricta, Pl. 9, fig. 14.

Syn. *N. constricta* Ald., Bull. No. 1, Geol. Surv. Ala., 1886, p. 24, pl. 5, fig. 13.
N. matthewensis Ald., *idem.*, p. 59.

Aldrich's original description.—"Shell broadly fusiform, whorls eight, spire high; suture distinct, whorls concave and compressed just below the suture; covered at this point with fine transverse lines, remaining space smooth. Body whorl large, smooth below the the above-mentioned sutural area, narrowed below into a short, stout canal which is marked by fine revolving lines. Aperture about two-thirds the length of the shell; outer lip sharp, thickened and crenulate within; inner lip concave above, straight below; callus not heavy.

"*Locality.*—Matthews' Landing, Ala."

Our specimens from this locality are fragmentary, hence I have copied Aldrich's figure. An imperfect cast from bed *b* at Hannah's, near Crainesville, Tenn., is quite probably of this species.

Several of our specimens indicate a size considerably greater than the figure.

LEVIBUCCINUM.

Levibuccinum lineatum, Pl. 9, fig. 15.

Syn. *L. lineatum* Heilp., Proc. Ac. Nat. Sci., Phila., 1880, p. 371, pl. 20, fig. 5.
L. lineatum Ald., Geol. Surv. Ala., Bull. 1, 1886, p. 59.

Heilprin's original description.—"Shell fusiform, of about seven

convex volutions, which are throughout their whole extent covered by fine, but distinct, revolving lines; aperture slightly exceeding the spire in length, sub-canaliculate anteriorly; columella gently arcuate; outer lip striate within.

"Length, 1 inch. Knight's Branch, Clarke Co., Ala.

"This species mainly differs from *L. prorsum* Con. in having the revolving lines equally distant over the entire surface of the whorls."

This species is typically developed in the Lignitic of Alabama, but a few specimens have been found in the Midway. Aldrich's specimen was from Matthews' Landing; ours are from Black Bluff and 1 mile west of Oak Hill P. O. A fragmentary specimen from the latter locality is shown by the figure.

PSEUDOLIVA.

Pseudoliva unicarinata, Pl. 9, fig. 16.

Syn. *P. unicarinata* Ald., Bull. No. 1, Geol. Surv. Ala., 1886, p. 19, pl. 5, fig. 17.

Aldrich's original description.—"Shell broadly ovate, whorls seven, sutural line wavy; spine [spire] sharp, the upper part rising suddenly from the flattened body whorl; nucleus composed of three smooth embryonic whorls. Body whorl shouldered, bearing large longitudinal ribs pointed at the angle, extending nearly to the sulcus below; above reaching to the suture, where they abruptly turn to the left and form rather deep pits between them. The carina of the body whorl has a raised line connecting the pointed part of the tuberculations; all the whorls below the nucleus show the tuberculations; sulcus rather deep. No umbilicus; entire surface covered with very fine revolving lines.

"*Locality.*—Matthews' Landing, Ala.

"Nearest to *Pseudoliva tuberculifera* Con.; but that species has strong revolving lines; its tubercles are lower down on the body whorl, not sharp; the sutural part is entirely different, and the shell is besides much more fusiform."

It seems as though Aldrich must have had a specimen of *P. scalina* before him when he wrote "spire sharp, the upper part rising suddenly from the flattened body whorl." Otherwise the description fits the figure.

Localities.—ALABAMA: Naheola; Matthews' Landing; 1 mi. W. of Oak Hill.

Type.—Collection of T. H. Aldrich.

Specimen figured.—Lea Memorial collection, Ac. Nat. Sci., Phila.

Pseudoliva ostrarupis, Pl. 9, figs. 18, 19.

Syn. *P. ostrarupis* Harris, Proc. Ac. Nat. Sci., Phila., 1895, p. 75, pl. 8, figs. 3, a.

Harris' original description.—"Size and general form as figured; volutions 6, spiral whorls shouldered and somewhat costate; suture obscured by foliæ developed by the intermittent mode of growth of the sutural callosity; body whorl below scarcely distinguishable from the non-umbilicate varieties of *P. vetusta*, while above, the shoulder and the sutural foliæ at once definitely characterize the species.

"*Locality.*—Smiley's Bluff, Brazos river, 2 miles above the mouth of Pond creek, Milam Co., Tex.

"*Geological horizon.*—Midway Eocene.

"*Type and specimen figured.*—Texas State Museum."

Pseudoliva ostrarupis var. *pauper*, Pl. 9, fig. 20.

Syn. *Pseudoliva ostrarupis* var. *pauper* Harris, Proc. Ac. Nat. Sci., Phila., 1895, p. 76, pl. 8, fig. 4.

Harris' characterization.—Figured without description.

Locality.—Smiley's Bluff, Brazos river, 2 miles above the mouth of Pond creek, Milam Co., Tex.

Geological horizon.—Midway Eocene.

Type.—Texas State Museum.

Pseudoliva vetusta, Pl. 9, fig. 17.

Syn. *Monoceros vetusta* Con., Foss. Sh. Tert. Form., 1833, p. 44, and p. 37, pl. 15, fig. 3, of 2d ed., 1835.

Conrad's original description.—"Subglobose, with revolving striæ, obscure, except the base, where they are distinct, spire short, rapidly narrowing to the apex, which is acute; tooth short and robust, placed at the termination of an exterior groove; basal margin profound; labrum acute on the margin."

The specimen so described was from Claiborne, Ala. It is known in nearly every horizon in our Eocene series.

The Midway specimens we obtained are all fragmentary, but several show clearly the characters of the species.

Localities.—ALABAMA: Matthews' Landing; Dale's Branch; 1 mi. W. of Oak Hill.

Type.—Ac. Nat. Sci., Phila.

Pseudoliva scalina, Pl. 9, fig. 21.

Syn. *P. scalina* Heilprin, Proc. Ac. Nat. Sci., Phila., 1880, p. 371, pl. 20, fig. 12.
P. scalina Ald., Geol. Surv. Ala., Bull. No. 1, 1886, p. 20, pl. 6, fig. 10.
? Harpa dechordata White, Arch. do Museu Nac. do Rio de Janeiro, p. 136, pl. 13, figs. 7, 8.

Heilprin's original description.—"Shell bucciniform, of about seven volutions; the whorls roughly plicated; the folds on the body whorl appearing as shoulder nodules; dentiferous sulcus well pronounced, followed by about five impressed revolving lines, which slightly crenulate the margin of the outer lip; revolving lines on the body whorl above the sulcus almost obsolete; aperture slightly exceeding the spire in length; columella callous; suture deeply channeled.

"Length, 1½ inch. Wood's Bluff, Clarke Co., Ala."

Localities (Midway).—ALABAMA: ⅓ mi. N. of Prairie Bluff; Matthews' Landing; ½ mi. W. of Graveyard hill; 1½ mi. S. W. of Palmer's mill; 1⅓ mi. N. E. of Clayton.

Pseudoliva sp., Pl. 9, fig. 22.

In the material collected from the railroad cut, 1⅓ mi. N. E. of Clayton, there is an imprint of a *Pseudoliva* showing the features represented by fig. 22, *i. e.*, a very pointed spire, minute or not strong nodes on the shoulder of the body whorl, a strong spiral channel rather high up on the body whorl and traces of spiral lines below. The vertical lines and the spiral lines on the shoulder are lines of shading only, the original specimen is of too coarse material to show such markings. More material must be collected before we can decide certainly whether this is or is not a variety of *P. tuberculifera* Con. On first sight it appears very distinct, but when the great variations of *P. vetusta* are borne in mind one becomes cautious in proposing new specific names. The figure is natural size.

TROPHON.

Trophon morulus, Pl. 10, fig. 1.

Syn. *Murex morulus* Con., Jr. Ac. Nat. Sci., Phila., vol. iv, 1860, p. 293, pl. 47, fig. 28.

Conrad's original description.—"Fusiform; whorls angular,

with distant spines on the angle, two or three of which are produced; ribs longitudinal, oblique, foliated, acute; angle of body whorl situated about the middle of the shell; beak sinuous, angle of aperture extending into an elongated, recurved spine.

"Length 5/8 inch."

Localities (Midway).—ALABAMA: Matthews' Landing; 1 mi. W. of Oak Hill P. O.

Type.—Ac. Nat. Sci., Phila.

MUREX.

Murex (*Pteronotus*) *matthewsensis*, Pl. 10, fig. 2.

Syn. *M. matthewsensis* Ald., Bull. No. 1, Geol. Surv. Ala., 1886, p. 18, pl. 3, fig. 15.

Aldrich's original description.—"Shell triangular, whorls probably four; angular, smooth between the varices; varices three, longitudinal, prominent; spines of the body whorl elongated and curved upward, the one at the angle of the aperture nearly closed; body whorl angulated on upper part, the other whorls rounded; aperture ovate, outer lip thick with a foliation at the junction with the body whorl running from the spine to the beak; inner lip smooth with a slight lamina; beak short; canal rather wide.

"*Locality*.—Matthews' Landing, Ala.

"Differs from *M. morulus* Con., in having no spines between the varices at the shoulder of the body whorl, and has no crenulations on the edge of the outer lip."

Localities.—ALABAMA: Matthews' Landing; 1 mi. W. of Oak Hill P. O.

Type.—Aldrich's collection.

TRITON.

Triton (*Ranularia*) *eocensis*, Pl. 10, fig. 3.

Syn. *Fulgur eocense* Ald., Bull. Am. Pal., No. 2, p. 10, pl. 3, figs. 7, 7a.

Aldrich's original description.—"Shell oblong fusiform; spire obtuse; whorls seven, angulated; whorls of the spire four in number and smooth, the others covered with fine revolving striæ; periphery of the last three whorls bounded by longitudinal tubercles, sometimes a double line of these appearing upon the upper whorls; body whorl with three strong carinæ, the one on the shoulder strongly tuberculose; one varix showing in all the

specimens; suture impressed, linear; outer lip internally denticulated and thickened; inner lip bearing a fold near base of aperture; canal long, nearly straight, slightly tortuous, bent upwards, finely striated to the extremity.

"*Localities.*—Matthews' and Gregg's Landings, Ala."

That this belongs to the Tritons is shown by a specimen in the writer's private collection from Gregg's Landing, better preserved about its aperture than any figured by Aldrich.

This species reminds one somewhat of *Rhinocantha* and *Haustellum* among the *Muricidæ*, but its agreement with certain species of the living *Ranularia*, *i. e.*, *Gutturnium* Klein, is closer still.

Localities (Midway).—ALABAMA: Matthews' Landing; Dale's Branch.

Type.—Aldrich's collection.

Triton (*Simpulum*) *showalteri*, Pl. 10, fig. 4.

Syn. *Simpulum showalteri* Con., Jr. Ac. Nat. Sci., Phila., vol. iv, 1860, p. 292, pl. 47, fig. 11.
Triton showalteri Ald., Geol. Surv. Ala., Bull. No. 1, 1886, p. 59.

Conrad's original description.—"Fusiform; whorls eight, angular, periphery of angle acute, situated below the middle of the whorl; whorls of spire costate longitudinally, but not very distinctly; revolving lines closely arranged, fine, with a few distant, prominent lines; three first whorls of the spire smooth, the next two tuberculated; angle tuberculated; a prominent, acute line on the body whorl runs from the upper extremity of the aperture, and a similar finer line between it and the angle above; columella rugose, with a prominent fold near its upper end; labrum dentate within.

"Length 1⅜ inches."

Conrad gives no definite locality for this specimen. He makes the general remark that this and other shells described in the same article are "from a locality farther north in Alabama than Mr. Tuomey had explored."

Locality.—ALABAMA: Matthews' Landing.

Type.—Ac. Nat. Sci., Phila.

PYRULA.

Pyrula juvenis, Pl. 10, figs. 5, 6.

Syn. *P. juvenis* Whitf., Am. Jr. Conch., vol. i, 1865, p. 259.

P. multangulata Heilp., Proc. Ac. Nat. Sci., Phila., 1886, p. 374, pl. 20, fig. 2.

? P. tricostata Heilp., *non* Desh., *ibid.*, p. 374, pl. 20, fig. 6.

P. juvenis Ald., Geol. Surv. Ala., 1886, p. 25, pl. 6, fig. 8.

Pyrula sp., Har., Geol. Surv. Ark., vol. ii, 1890, p. 46, pl. 3, fig. 3.

Whitfield's original description.—"Shell small and fragile; spire elevated; columella slender, slightly bent; aperture large, elongate, ovate or subelliptical; volutions three, marked on the periphery by three distinct carinæ or subangular revolving ridges, the upper one marked with closely arranged longitudinally elongate nodes, the others simple; entire surface marked by very fine revolving lines, which are somewhat fasciculate below the lower carina, there being three finer ones between each large one.

"*Dimensions.*—Length .6 inch, transverse diameter a little less than .3 inch.

"*Locality.*—Six miles above Claiborne, Alabama, west side of river."

This species is remarkable for its variability. Two forms are shown by the figures. Whitfield's specimen had but three carinas, while the Midway specimens often have four and a trace of a fifth; one or two of the apical whorls smooth, the third passing from obliquely costate to bicarinate, the fourth strongly bicarinate, the carinas crenulate. Obscure oblique ribbing is often seen connecting the nodes on the two carinas.

Localities—ARKANSAS: Near Olsen's switch, a few miles S. W. of Little Rock. See Ann'l Rep't Geol. Surv. Ark., vol. ii, pl. 3, fig. 3.
ALABAMA: Matthews' Landing; 1 mi. W. of Oak Hill; ½ mi. W. of Graveyard hill.

CYPRÆA.

Cypræa sp.

We have encountered two species of this genus in the Midway stage. One, a small, smooth species like the Jackson specimens was found ½ mile north of Ripley, Miss. The other, a small, reticulated species like *C. lintea* Con., was obtained from the uppermost Midway limestone as it crops out at Ft. Gaines, on the Chattahoochee. Neither are sufficiently well preserved to merit figuring or further description.

*CALYPTRAPHORUS.**

Calyptraphorus velatus var. *compressa*, Pl. 10, figs. 7, a, b, 8.

Syn. *Anchura* White, U. S. Geol. Surv., Bull. No. 4, 1884, p. 17.
Rostellaria velata Ald., Geol. Surv. Ala., Bull. No. 1, 1886, p. 59.
Rostellaria Smith and Johnson, U. S. Geol. Surv., Bull. No. 43, 1887, p. 66.
Calyptraphorus velatus Harris, Geol. Surv. Ark., vol. ii, 1892, p. 46.
Rostellaria (*C.*) *velatus* var. *compressa* Ald., Geol. Surv. Ala., 1894, p. 244, pl. 12, figs. 2, 2a, 2b.

Aldrich's characterization of this variety.—"This form is intermediate between *R. trinodifera* Con. and *R. velata* Con. The adult has the enamel on the front part as in *R. trinodifera*, but on the opposite side the line of demarkation of the enamel comes down only to the [body] whorl. The specimens are also much smaller than the normal adult. A similar form that cannot be separated from this variety is common in the Matthews' Landing group but is nearly twice as large, more rotund than those figured. The figures given are somewhat larger than the type."

The smaller type of this variety is common in the lower and medial Midway beds. It is one of the first to appear above the Eocene–Cretaceous contact line. The larger specimens differ from *Calyptraphorus velatus* from the Claiborne sand mainly by the pointed exterior-posterior termination of the labrum; in *velatus* this portion of the labrum is rounded, as shown by figure 5, plate 15, of Conrad's Fossil Shells, etc., 1835.

Localities.—TEXAS: Brazos river, at and near the Cretaceous–Eocene contact.
ARKANSAS: Near Olsen's switch, a few miles S. W. of Little Rock.
TENNESSEE: Hannah's, 1¾ mi. N. or N. E. of Crainesville; ½ mi. W. of Hannah's; Huddleston's; Middleton.
MISSISSIPPI: ½ mi. N. of Ripley; 1 mi. E. of Ripley; ½ mi. S. of Ripley C. H.

* Fischer in his *Manuel de Conchyliologie*, p. 672, has emended the orthography of this word so that it reads *Calyptrophorus*. Although we used the emended form of the word in the geological part of this work, we do not hesitate, on further consideration of the subject, to return to Conrad's original spelling.

ALABAMA: Naheola; Matthews' Landing; 1 mi. N. of Midway; 2 mi. N. of Snow Hill; Josh Hunter's; Dale's Branch; ½ mi. W. of Graveyard hill; 2 mi. W. of Oak Hill; 1½ mi. S. W. of Palmer's mill, on McConnico's plantation; at Palmer's mill, see frontispiece; Cole's place, 1 mi. W. of Palmer's mill; 1 mi. S. W. of Clayton; 1⅓ mi. N. E. of Clayton.

GEORGIA: Base of Midway, Chattahoochee river; not far above the mouth of Sandy creek, Chattahoochee river.

APORRHAIS.

Aporrhais sp., Pl. 10, fig. 9.

We have as yet obtained no really good specimens of this genus in the Midway. The figure represents an imperfect specimen obtained from near the southeast line of Hogan's Survey, Falls county, on the west bank of the Brazos. It is quite probably *A. gracilis* Aldrich, since that author lists it from Black Bluff, Ala. Similar specimens were found by the writer near Tehuacana, Texas, about 50 feet below the Midway limestone ledges. A cast in our last summer's collection is from 1 mile north of Midway; it is with little doubt *A. gracilis*.

CERITHIUM.

Cerithium (*Companile*) *claytonense*, Pl. 10, figs. 10, 11.

Syn. *C. claytonense* Ald., Geol. Surv. Ala., 1894, p. 246, pl. 13, figs. 1, a, b.

Aldrich's original description.—"Shell large, rapidly tapering, whorl remaining, thirteen, each banded by a broad nodulous raised space alternating with four or five deeply cut spiral lines, sometimes showing a fine raised line in the depressions, columella showing internally two plications between the whorls.

"No perfect specimens yet found but the species is very distinct and much larger than hitherto known from our Eocene. Length of largest specimen 125 mm. Specimen showing internal structure from the National Museum; the other from the State Survey collection."

The locality whence these large specimens were derived was doubtless McConnico's plantation, 1½ mi. S. W. of Palmer's mill. Mr. Stonewall McConnico very generously gave us a specimen nearly equal in size to that shown on plate 10, figure 11.

It shows that between the three spiral lines of each whorl there are sometimes as many more, somewhat less conspicuous, still very evident. Another specimen shows the columellar plaits as in fig. 10, pl. 10; they are, however, somewhat more acute. On the base of each whorl there is a strong, median spiral ridge.

A fragment of a large whorl presumably of this species was found in the uppermost bed of the Midway limestone as exposed on Chattahoochee river at Ft. Gaines.

Cerithium gainesensis n. sp., Pl. 11, fig. 1.

Specific characterization.—Size and general form as indicated by the figure; whorls about 13; 1 to 10 with 15 to 25 low ribs nearly equal to the interspaces, crossed by three strong, subequal, primary spirals, between which there are in well preserved specimens thread-like lines of secondary order; sometimes granular at junction of the ribs and primary spirals; sides of whorls nearly regularly convex but with a tendency to become slightly constricted for a little distance below the suture, then gradually rounding in the middle and slightly gibbous below, the variation from a circular curve, however, is very slight; the whorls 11 and 12 are but slightly ornamented, generally with a varix or two and with a few slight indications of ribs and with three or four faint spirals; the middle one is sometimes on a very slight carination; body whorl with generally one varix, with anterior and posterior canal, and with outer lip sharp on the edge but thickening rapidly within.

In some specimens there are four primary spirals on each whorl.

Dall has described a fragment of a spire of a *Cerithium* from Jacksonboro, Ga., under the name of *C. platynema*. At first I was inclined to think that fragment might possibly be *gainesensis*, for the ribbing and three strong spirals with finer lines seemed to agree very well with Dall's species; but I fail to find any trace of the broad plain spiral at the base of each lower whorl as is noted in both Dall's figure and description. Mr. Hubbard and I collected a large number of specimens of *gainesensis*, and although all are in the forms of moulds and casts, gutta-percha impressions of them show every portion of the species many times. Common.

Locality.—GEORGIA: Uppermost Midway as exposed on the Chattahoochee at Ft. Gaines.

Type.—Paleontological Museum, Cornell Univ.

Cerithium globoleve n. sp., Pl. 11, fig. 2.

Specific characterization.—Size and general form as indicated

by the figure; whorls about 12, increasing in size regularly from the apex, the penultimate the largest; surface smooth, lines of growth scarcely perceptible, slightly recurved centrally; suture distinct but not deep; body whorl slightly compressed centrally with a few inconspicuous spiral lines at base crossed by lines of growth; anterior canal short, decurved; posterior margin of the mouth showing a small posterior canal.

The figure is of a gutta-percha impression, and does not show the canal as does the mould from which the impression was made. Other specimens also show the deflected anterior canal and traces of the posterior.

Locality.—ALABAMA: Common in the R. R. cut, 1⅓ mi. N. E. of Clayton.

Type.—Paleontological Museum, Cornell Univ.

Cerithium mediaviæ n. sp., Pl. 11, figs. 3, a.

Specific characterization.—Size and general form as shown by the figures; whorls 10-12, marked by costæ nearly equal in width to the interspaces, about 15 on the penultimate whorl, not so many above; suture sharply defined; each whorl with five or six sharp, raised, spiral lines between which as many more finer ones often appear; body whorl with costæ becoming obsolete below the middle, anterior canal short and deflected, posterior margin of the mouth calloused and grooved, forming a posterior canal.

It seems a pity that this *Cerithium* so characteristic of the limestone ledges N. E. of Clayton could not be called *claytonense*, but this name is already preoccupied by the large species from Wilcox Co. and which unfortunately is unknown at Clayton.

Locality.—ALABAMA: In the light yellowish limestone ledges in a R. R. cut, 1⅓ mi. N. E. of Clayton.

Type.—Paleontological Museum, Cornell Univ.

Cerithium penrosei, Pl. 11, fig. 4.

Syn.—*C. penrosei*—Proc. Ac. Nat. Sci., Phila., 1895, p. 79, pl. 9, fig. 4.

Harris' original description.—"Whorls at least 15, gradually tapering, ornamented as follows: by (1) about seven laterally compressed, oblique subcentral or basal nodes, or costæ on each whorl, those on the smaller whorls of the spire not so distinctly defined as represented by the figure; by (2) spiral lines or striæ, about five of which are strong and occupy the lower one-third

of each whorl, three or four more are finer and occupy a narrow, irregular, central zone, while four or five more occupy the upper or non-costate portion of the whorls. The costæ on the several whorls are arranged in lines corresponding in direction to the obliquity of the costæ.

Unfortunately only fragments of this large *Cerithium* have been found; it doubtless measured eight or ten inches in length when entire.

"*Locality.*—Smiley's Bluff, Brazos river, 2 miles above the mouth of Pond creek, Milam Co., Texas.

"*Geological horizon.*—Midway Eocene.

"*Type.*—Texas State Museum."

TURRITELLA.

Turritella tennesseensis. Pl. 11, fig. 5.

Syn. *T. tennesseensis* Gb., Jr. Ac. Nat. Sci., Phila., vol. iv., 1860, p. 392, pl. 68, fig. 13.

Gabb's original description.—"Turrited, spire high; whorls? (10?) flattened or concave on the side, carinated strongly below; mouth subquadrate; surface marked by numerous revolving striæ, two or three of which are generally larger than the rest, the remainder usually alternating, one or two small ones with one slightly larger.

"Length (restored)?, 1.2 in.?, width of body whorl one inch from apex, .35 in.

"*Locality.*—Hardeman Co., Tenn., marls of Ripley Group. Prof. Safford."

We have all of Gabb's specimens before us. Two small ones are doubtless the young of *T. mortoni;* and the others should be placed in the same section, if not under the same specific name. Fig. 5 shows the characters of this so-called species. It will be noticed that the line some distance below the suture is more pronounced than in fig. 6, *T. alabamiensis*, and that the basal carination is somewhat more noticeable. This as well as the following three species? are quite probably but variations of *T. mortoni.*

Localities.—TENNESSEE: R. R. cut, 2 mi. E. of Middleton, (the specimen figured); 2 mi. S. of Middleton.
GEORGIA: Near base of Midway, Chattahoochee river.

Type.—Collection of Dr. Safford, Vanderbilt Univ., Tenn.

Turritella alabamiensis, Pl. 11, fig. 6.

Syn. *T. alabamiensis* Whitf., Am. Jr. Conch., 1, 1865, p. 267.
T. alabamensis Ald., Geol. Surv. Ala., 1894, p. 246, pl. 13, fig. 2.

Whitfield's original description.—"Shell slender; volutions twelve or more; subquadrangular, lower margin sometimes projecting; suture distinctly marked; aperture subelliptical, slightly oblique; surface marked by numerous fine revolving lines, which are scarcely alternate, and crossed by distinct lines of growth, which make a deep sinus on the body of the volution, and are again bent backwards on the lower angle.

"This species scarcely differs from *T. cœlata* Conrad, from the Vicksburg (Miss.) beds, except that it is destitute of the lines of granules which give so decided a character to that species.

"*Locality.*—Nine miles below Prairie Bluff, Alabama.

The figure given herewith is the same as that shown on plate 13 of Aldrich's work referred to above. It is of the same general shape as the typical specimens from Matthews' Landing, but lacks the sharp spiral and longitudinal sculpturing of the latter. We are inclined to regard this species as but a marked variety of *T. mortoni*.

Localities.—TEXAS: Brazos river, not far from the Cretaceous–Eocene contact.
ARKANSAS: Near Olsen's switch, a few miles S. W. of Little Rock.
ALABAMA: Matthews' Landing; 1½ mi. S. W. of Palmer's mill; Dale's Branch; 1 mi. W. of Oak Hill; ½ mi. W. of Graveyard hill.

Type.—Hall collection.

Turritella saffordi, Pl. 11, fig. 7.

Syn. *T. saffordi* Gabb, Jr. Ac. Nat. Sci., Phila., vol. iv, 1860, p. 392, pl. 68, fig. 12.

Gabb's original description.—"Scalariform; whorls eight or ten, somewhat carinated below, flattened on the side; suture profound; mouth subquadrate; surface marked by three small revolving lines on the lower portion of the whorl, near the suture, and on some specimens by obscure revolving lines near [on] the whole whorl, always crossed by waved lines of growth.

"*Dimensions.*—Length (restored) 2.2 in., width of body whorl .6 in., length of mouth .4 in.

"*Locality.*—Hardeman Co., Tenn. Prof. Safford. From the light grey limestone alternating with the marls of the Ripley Group."

This species? is only another form that can be traced directly into *T. mortoni*. Larger specimens occur in great abundance in the so-called Turritella rock of Tippah Co., Miss., especially ½ mile south and two miles east of Ripley. A larger specimen of a slightly different form is shown by fig. 8, pl. 11. This was obtained from the Midway limestone, 1¾ miles N. E. of Bradford station, Ark.

Type of this (species?).—Collection of Jas. M. Safford. One of these type specimens is shown by fig. 7.

Turritella mortoni var. *levicunea* n. var., Pl. 11, fig. 9.

This variety differs from typical *T. mortoni* by its greater apical angle, its finer striation and the lack of a strong subcentral carina on the whorls.

Localities.—ALABAMA: Matthews' Landing; Dale's Branch.
GEORGIA: Ft. Gaines.

Type of variety.—Paleontological Museum, Cornell Univ.

Turritella mortoni Con. is doubtless represented by the foregoing so-called species (figs. 5-8), but it also occurs in the form of casts in great abundance, large size and of most typical form in a soft layer in the Midway limestone near its base along the Chattahoochee river.

Other Midway localities whence more or less typical forms have been obtained are:—

TEXAS: 4 mi. N. of Kemp, Kaufman Co.
ARKANSAS: Sect. 9, 1 S., 14 W.; near Olsen's switch; Johnson's well, Little Rock.
TENNESSEE: Hannah's, 1¾ mi. N. E. of Crainesville; Middleton.
MISSISSIPPI: ½ mi. N. of Ripley.
ALABAMA: At and near the Cretaceous–Eocene contact line in many localities about Prairie Bluff; 1 mi. N. of Midway; ½ & 2 mi. N. of Snow Hill; Palmer's mill; 1½ mi. S. W. of Palmer's mill.

Turritella humerosa, Pl. 11, figs. 10?, 11, 12, 13.

Syn. *T. humerosa* Con., Trans. Geol. Soc., Penn., vol. i, 1835, p. 340, pl. 13, fig. 3.
T. eurynome Whitf., Am. Jr. Conch., vol. i, 1865, p. 266.
T. multilira Whitf., *ibid.*, p. 266.
T. bellifera Ald., Geol. Surv. Ala., 1886, Bull. No. 1, p. 34, pl. 1, fig. 13.

T. cathedralis var. *bellifera* De Greg., Mon. Faun. Eoc. Ala., 1890, p. 127, pl. 11, figs. 17 & 38.

Conrad's original description.—"Shell turrited, subulate; whorls with fine regular revolving striæ; an obtuse slight elevation on the summit, a shallow groove at base of each.

"From the Eocene of Piscataway, Maryland."

Though this species is most typically represented in the Lignitic of Alabama, Virginia and Maryland, it occurs very abundantly in nearly all horizons of the Midway and displays a remarkable variety of forms.

Fig. 10 is of doubtful reference to this species and is the figure termed by Aldrich *T. humerosa* var. *multilira*, Geol. Surv. Ala., 1894, p. 246, pl. 13, fig. 3. Fig. 11 is more nearly typical *humerosa*, it is also after Aldrich. Fig. 12 is a large form belonging to the U. S. National Museum, marked "No. 204, Prairie Creek." It is doubtless from near Oak Hill, bed 9 of section p. 31. Fig. 13 is a very strongly lirate variety from Horn hill, Limestone Co., Tex.

Localities (Midway).—TEXAS: Horn hill; Tehuacana.
ARKANSAS: Near Olsen's switch, a few miles S. W. of Little Rock.
ALABAMA: Matthews' Landing; 2 mi. N. of Snow Hill; 1⅓ mi. N. E. of Clayton.

Turritella nerinexa, Pl. 11, fig. 14.

Syn. *T. nerinexa* Harris, Proc. Ac. Nat. Sci., Phila., 1895, p. 82, pl. 9, fig. 9.

Harris' original description.—"Size and general form of a fragment (the only known specimen) as indicated by the figure; number of whorls unknown, ornamented by (1) fine, even, spiral striæ, (2) a subsutural row of pustules or crenules, and (3) a slightly raised or faint ridge at the base of each whorl becoming obsolete in the lower whorls, but increasing in strength above so as to nearly equal in size the subsutural line of crenules.

"*Locality.*—Black Bluff, Brazos river, extreme northern limit of Milam Co., Milam Bluff of Penrose's Report.

"*Geological horizon.*—Midway Eocene.

"*Type.*—Texas State Museum."

This species has much in common with *Nerinæa buarquiana* White from the Midway of Maria Farinha. A large specimen of a similar species was found in Eastern Brazil.

Locality.—ALABAMA: ⅓ mi. N. W. of Prairie Bluff.

MESALIA.

Mesalia pumila, Pl. 11, fig. 15.

Syn. *Turritella pumila* Gabb, Jr. Ac. Nat. Sci., Phila., vol. iv, 1860, p. 392, pl. 68, fig. 14.

Gabb's original description.—"Turrited, whorls? (spire is broken) rounded and strongly striate; mouth round; shell very thick; surface marked by three heavy revolving lines on the convexity of the whorl, and one at the base just above the suture, which is small but distinct.

"*Dimensions.*—Length of fragment .5 in., width of body whorl .3 in., diameter of mouth .1 in.

"*Locality.*—With the above. Prof. Safford."

There is little doubt in the writer's mind that if enough material were at hand this would grade into "*Potamides*" *alabamiensis* Whitf.

By examining Gabb's types of this species it will be seen that the one he had most in mind and the one he figured is from a clay bank two miles south of Middleton, associated accordingly with his *Turritella hardemanensis*. The other specimens, see fig. 18, are from the limestone on Muddy creek, east of Middleton.

The specimens from the limestone beds classified by Gabb as *pumila* but certainly more nearly *hardemanensis* are from:—

TENNESSEE: Muddy creek, E. of Middleton; ½ mi. S. of Middleton; 2 mi. E. of Middleton.

Type.—Collection of Dr. Safford.

Mesalia pumila var. *wilcoxiana*, Pl. 11, figs. 16, 17.

Syn. *Turritella wilcoxiana* Ald., Geol. Surv. Ala., 1894, p. 247, pl. 13, fig. 4b.

This was described by Aldrich as a species of *Turritella* from the Midway of Alabama. Since it comes from the same stage as *M. pumila* and bears to it so close a resemblance we have little hesitation in calling all one and the same species with but varietal differences.

Localities.—TEXAS: 1 mi. up Salt branch of Little Brazos river; Tehuacana.

ALABAMA: 1 mi. S., 1½ mi. S. W., and 1 mi. W. of Palmer's mill; 1 mi. N. of Midway.

Type.—Aldrich's collection.

Mesalia pumila var. *hardemanensis*, Pl. 11, fig. 19.

Syn. *Turritella hardemanensis* Gabb, Jr. Ac. Nat. Sci., Phila., 1860, p. 392, pl. 68, fig. 15.

We have figured one type specimen which belongs to Dr. Safford's collection. It is labelled as coming from 2 miles south of Middleton, Tenn. Of the three type specimens all are young or small and hence do not show well the characters of the species. An older specimen is shown by fig. 18. This was found in with *T. pumila* as labelled by Gabb or Safford.

Localities of this variety.—TEXAS: Kemp, Kaufman Co.
ARKANSAS: Johnson's well, Little Rock; Olsen's switch, a few miles S. W. of Little Rock.
TENNESSEE: Muddy creek, E. of Middleton.
MISSISSIPPI: 2 mi. E. of Ripley.
GEORGIA: Base of Midway, Chattahoochee river.

Mesalia pumila var. *allentonensis*, Pl. 11, figs. 20, 21.

Syn. *Turritella allentonensis* Ald., Geol. Surv. Ala., 1894, p. 246, pl. 13, fig. 4a & 6.

This form as shown by the figures seems to us to be simply one of the *pumilæ*. The gradations from one into all the other varieties seem quite complete.

Locality.—ALABAMA: On or near McConnico's plantion, 1½ mi. S. W. of Palmer's mill.

Aldrich's collection.

Mesalia alabamiensis, Pl. 12, fig. 1.

Syn. *Potamides alabamiensis* Whitf., Am. Jr. Conch., vol. i, 1865, p. 266, pl. 27, fig. 13.

Whitfield's original description.—"Shell turrited, consisting of about eight short, strong, rounded volutions; columella short; aperture obliquely ovate, lower basal portion auger-shaped; entire surface marked by strong, sharply elevated, revolving lines, strongest on the middle of the volution; eleven can be counted on the body whorl; the revolving lines are crossed by faint lines of growth, which have a slight sigmoidal curve.

"*Dimensions.*—Length of shell 1.12 inches, transverse diameter of body whorl .45 inch.

"*Locality.*—Six miles below Prairie Bluff, Alabama."

This is evidently the descendant of, or perhaps is identical with, *M. pumila* Gabb. In the lower Lignitic of Alabama it shows a vast amount of variation. The specimens herewith referred to this species are of nearly typical form, but are small.

Locality.—ALABAMA: ½ mi. W. of Graveyard hill.

Type.—Hall collection.

Mesalia watsonensis n. sp., Pl. 12, fig. 2.

Specific characterization.—Size and general form as indicated by the figure; whorls about 10, each marked by three strong, spiral lines, the two upper not so strong as the lower which forms a distinct carina at the base of each whorl; suture profoundly impressed; lines of growth varying in size, passing downward and backward over the upper two spiral lines, then turning downwards, and after crossing the lower carinal line, passing again slightly to the rear; irregularity of the spiral lines causing a slight ribbing with faint nodules on the stronger spiral lines; on the base of the body whorl there are three additional strong spiral raised lines.

Locality.—ALABAMA: Common in the light yellow limestone ledges in the R. R. cut, 2 mi. N. E. of Clayton, Barbour Co.

Type.—Paleontological Museum, Cornell Univ.

Mesalia?, Pl. 12, fig. 3.

This peculiar little specimen was found at Matthews' Landing, Ala. It is certainly too imperfect for full characterization.

Impressions of a very similar or identical species occur in the lowest Midway layer (Turritella rock), 2 miles east of Ripley, Miss., and at the same horizon on Chattahoochee river, Ga.

SOLARIUM.

Solarium alabamense, Pl. 12, fig. 4.

Syn. *S. alabamense* Dall, Trans. Wag. Fr. Inst. Sci., vol. iii, p. 324, pl. 22, fig. 11.

Dall's original description.—"Shell with two and a half whorls besides the nucleus; umbilicus shaped like that of *Patulaxis* with no rib but, as well as the rest of the surface, finely regularly spirally threaded, the threads delicately reticulated by arcuate lines of growth; form depressed, the umbilical carina simple, the upper surface of the whorls somewhat rounded, but bordered by a double, elevated thread, while the periphery (including the lateral aspect of this thread) has a vertical surface, like the tire of a wheel, which offers three strong, elevated, rounded threads with two fine intercalary elevated lines. Alt. of shell 2.0; max. diam. 5.3 mm."

This was described from Matthews' Landing, Ala. Our specimen is from 1 mile west of Oak Hill.

Type.—U. S. National Museum.

Solarium periscelidum, Pl. 12, fig. 5.

Syn. *S. periscelidum* Dall, Trans. Wag. Fr. Inst. Sci., vol. iii, 1893, p. 325, pl. 22, fig. 11.

Dall's original description.—"Shell depressed, rather small, with four or more post-nuclear whorls; periphery with a rather strong annulate rib with a fainter one on each side, the one behind separated by a well-marked, sometimes excavated, interspace; suture appressed, with a granular line in front of it and often several feebler rows in front of that, the surface of this part of the whorl somewhat concave or flattish; base rounded from the keel to the umbilical carina, which is nodular, with or without a few broken fine spirals outside of it, crossed by weakening radial wrinkles; umbilicus rather wide, with a small, well-marked, annulate umbilical rib, and the walls transversely wrinkled and somewhat concave. Alt. 4.2; max. diam. 9.0 mm."

Localities.—ALABAMA: Matthews' Landing; 1 mi. W. of Oak Hill; ? casts, 1 mi. N. of Midway.

Type.—Aldrich collection (specimen figured).

Solarium sp., Pl. 12, fig. 6.

This is evidently a young shell and bears a strong resemblance to the smaller whorls of *S. cupola* Heilprin, but the largest whorl does not begin to show signs of a deflected margin, nor are the subsutural spirals present. Better specimens may permit of specific description.

Locality.—ALABAMA: Matthews' Landing.

Specimen figured.—Paleontological Museum, Cornell Univ.

RISSOINA.

Rissoina alabamensis, Pl. 12, fig. 7.

Syn. *Rissoina alabamensis* Ald., Bull. Am. Pal., No. 2, 1895, p. 14, pl. 2, fig. 8.

Aldrich's original description.—"Shell solid; whorls nine, the first four smooth, embryonic, then follow four rounded adult whorls showing fine spiral lines which are slightly pitted at the intersections of lines of growth with them; body whorl rounded, convex, contracted below centre to form the base on which the lines of growth are more strongly marked; aperture oblong-ovate outer lip channelled anteriorly, thickened and expanded posteriorly and strongly sigmoid.

"*Locality.*—Matthews' Landing, Ala."

Type.—Aldrich's collection.

Specimen figured.—Lea Memorial collection, Ac. Nat. Sci., Phila.

KEILOSTOMA.

Keilostoma mediavia n. sp., Pl. 12, figs. 8, 9, a.

Specific characterization.—General form and size as indicated by the figures, though sometimes slightly thicker or less elongate; whorls about eleven, generally with very faint longitudinal plications, uppermost whorls with rounding sides, medial ones with straight sides and body whorl with sometimes a slight medial depression; no spiral striæ; surface semi-polished; suture distinct, somewhat shouldered below; mouth typical of the genus, *i. e.*, with a strong labial callosity which passing beneath comes up on the outside of the labrum as a flattened varix which shows a few longitudinal lines of growth.

Fig. 8 is of a specimen collected by the writer, 1895, and now in Cornell Univ. Pal. collection, while figs. 9, 9a, are of a specimen in the U. S. Nat. Mus. collection, collected by L. C. Johnson about 10 years ago. A few years ago while looking over the Eocene material in the U. S. Nat. Mus. collection, I was struck with the resemblance this form bore to Gabb's *Loxotrema;* but Deshayes' *Keilostoma* seems to fit it so much better I have no hesitation in referring it to that genus. In fact our species is very closely allied to Deshayes' *plicatula*, Coq. Foss. des Env. de Paris, 1824, vol. ii, p. 115, pl. 14, figs. 5, 6, from the lower beds of the Paris Basin Eocene. "Abbecourt près Beauvais."

See also Descr. An. Sans Vert., etc., vol. ii, p. 426.

Localities.—ALABAMA: The exact localities of the U. S. Nat. Mus. specimens are not known though they came from Wilcox Co., Sta. 264. Specimens preserved in the same material, limestone, are in our collection from ½ mi. E. of S. McConnico's, or perhaps 1½ mi. S. W. of Palmer's mill. They are from bed 18 of our section. Others preserved as casts were found in bed 21 of the same general section, that is, in the light, micaceous sandstone ledges beneath Palmer's mill. Still another is from the railroad cut, 1⅓ mile N. E. of Clayton.

Types.—Paleontological Museum, Cornell University, and U. S. National Museum.

CALYPTRÆA.

Calyptræa sp., Pl. 12, figs. 10, 11.

The two specimens (casts only) were collected in the R. R.

cut, 1⅓ miles N. E. of Clayton. Another specimen was obtained 1 mile N. of Midway.

XENOPHORA.

Xenophora sp., Pl. 12, figs. 12, 13.

Two casts of specimens belonging to this genus were found in Alabama, both of which are herewith figured. One is from 1 mile N. of Midway, the other from 1 mile N. of Prairie Bluff.

NATICA.

Natica (*Girodes*) *alabamiensis*, Pl. 12, fig. 14.

Syn. *N.* (*G.*) *alabamiensis* Whitf., Am. Jr. Conch., 1, 1865, p. 265, pl. 27, figs. 9, 10.

Whitfield's original description.—"Shell oblique, subpalutose; spire elevated; volutions four, flattened on top; aperture large, broadly subovate, columella flattened and slightly grooved; umbilicus minute or none; surface marked by fine, wavy revolving lines, strongest near the upper part of the volution, crossed by distinct lines of growth.

"*Dimensions.*—Length .80 inch, width .62 inch.

"*Locality.*—Six miles above Claiborne, Alabama, west side of river."

Localities.—ARKANSAS: ? Near Olsen's switch, a few miles S. W. of Little Rock.
ALABAMA: Naheola; Matthews' Landing; 1 mi. W. of Oak Hill P. O.

Type.—Hall collection.

Natica mediavia n. sp., Pl. 12, fig. 15.

Specific characterization.—General form and size as indicated by the figure (a cast); composed of about 5 whorls, very small above, while the body whorl is very large; sides of whorls rounded, slightly shouldered or flattened above; suture well marked; mouth elliptical in general outline but pointed above; outer lip acute at the margin but thickening very rapidly within and forming a varix; substance of the shell thin.

The thickened outer lip reminds one of *N. subpatula* Desh., of the Paris Basin, but the lip thickens even more rapidly. Fragments indicate specimens of considerably larger size than the specimen figured.

Localities.—GEORGIA: Uppermost Midway limestone as exposed on Chattahoochee river at Ft. Gaines.

ALABAMA: 1⅓ mi. N. E. of Clayton.

Type.—Paleontological Museum, Cornell University. Specimen figured, from Ft. Gaines.

Natica limula, Pl. 12, fig. 16.

Syn. *N. limula* Con., Foss. Sh. Tert. Form. Am., Nov., 1833, p. 46.
N. gibbosa Lea, Cont. to Geol., Dec., 1833, p. 108, pl. 4, fig. 92.
N. (*Neverita*) *mamma* De Greg., *partim*, Mon. Faun. Eoc. Ala., 1890, p. 152.

Conrad's original description.—"Obliquely suboval, smooth, with a short convex spire; umbilicus nearly closed by a profound callus; aperture elliptical."

The specimen so described was from the Claiborne sand and is now in the collection of the Ac. Nat. Sci., Phila.

The specimen herewith figured is from Matthews' Landing and belongs to the Chamberlain–Lea collection at the Ac. Nat. Sci., Phila. We are not aware that the species has been recorded before from so low a horizon.

Natica (*Polinices*) *onusta*, Pl. 12, fig. 17.

Syn. *N.* (*P.*) *onusta* Whitf., Am. Jr. Conch., 1, 1865, p. 264.

Whitfield's original description.—"Shell obliquely elliptical; spire low, a very small portion only of the inner volutions showing; volutions flattened in the upper part, and abruptly rounded below; suture slightly channelled; aperture very large, obliquely semilunate; callus very large, entirely filling the umbilical portion of the shell; surface smooth, or marked only by fine lines of growth.

"*Locality.*—Six miles below Prairie Bluff, Alabama."

Type.—Hall collection.

Natica saffordia n. sp., Pl. 12, fig. 18.

Syn. *N. rectilabrum* Gabb and Safford *non* Con., Geol. Tenn., Safford, 1869, p. 419.

Specific characterization.—Size and form about as figured though there is a slight tendency towards a humeral zone just below the suture, somewhat as in *alabamiensis* though far less marked; whorls from four to five; umbilicus small, nearly closed by the thickening of the labium. In young specimens, as in many species of the genus, there is a trace of a notch or transverse

groove across the labium at about the horizon of the upper margin of the umbilicus.

Mr. Stanton of the U. S. National Museum has sent us a fine set of *N. rectilabrum* Con. from the upper Cretaceous. They are far more elongate and *Vivipara*-shaped than *saffordia*.

Locality.—TENNESSEE: 2 mi. E. of Middleton.

Type.—Dr. Safford's collection.

Natica reversa, Pl. 12, fig. 19.

Syn. *N. reversa* Whitf., Am. Jr. Conch., 1, 1865, p. 264.

Whitfield's original description.—"Shell small, globose; spire moderately elevated; volutions ventricose; suture deep; aperture semicircular, and moderately large, equaling two-thirds the length of the shell; outer lip sharp; inner lip slightly thickened, spreading over the preceding volution; callus represented by a thickened spiral ridge, deposited on the left side of the umbilicus, and uniting with the peristome at the inner basal angle; substance of the shell thick; surface polished.

"*Dimensions*.—Height .3 inch.

"*Locality*.—Nine miles below Prairie Bluff, Ala."

Localities.—ALABAMA: Matthews' Landing; 1 mi. W. of Oak Hill.

Type.—Hall collection.

Natica eminula, Pl. 12, fig. 20.

Syn. *N. eminula* Con., Foss. Sh. Tert. Form., 1833, p. 46.
N. parva and *minor* of Lea's Contributions, etc.

Conrad's original description.—"Obovate, with smooth convex volutions and a prominent conical spire; umbilicus elliptical, not contracted by the callus; aperture obovate, rather more than half the length of the shell."

This was described from the Claiborne sand.

Localities (Midway).—ALABAMA: Naheola; Matthews' Landing; 1 mi. W. of Oak Hill P. O.

Type.—Ac. Nat. Sci., Phila.

Natica perspecta, Pl. 12, fig. 21.

Syn. *N. perspecta* Whitf., Am. Jr. Conch., 1, 1865, p. 264.

Whitfield's original description.—"Shell oblique, of medium size; substance thick; volutions four in the largest individuals, very ventricose; spire low; suture very distinctly channelled;

umbilicus proportionally large, entirely destitute of a callus, the volutions being distinctly visible to the apical one; aperture semilunate, the inner lip spreading somewhat on the preceding volution, opposite the umbilicus it is thin and emarginate; outer lip sharp; surface polished.

"This beautiful little shell differs from any described species, in the deep channelling of the suture and the characters of the umbilicus.

"*Locality.*—Nine miles below Prairie Bluff, Ala."

Localities.—ALABAMA: ½ mi. W. of Graveyard hill; Matthews' Landing.

Type.—Hall collection.

AMAURA.

Amaura (*Amauropsis?*) *tombigbeensis* n. sp., Pl. 12, fig. 22.

Specific characterization.—Size and general form as indicated by the figure; non-umbilicate; shell very thin and fragile, marked by very fine, even lines of growth and by a vast number of fine, even, revolving, incised lines, tending slightly to alternate in depth about the umbilical region; suture distinct, whorls slightly shouldered below the suture, two or three stronger revolving lines on this humeral zone; lines of growth when passing downward from the suture, are directed slightly backwards as compared with the axis of the shell.

Localities.—ALABAMA: 4 mi. below Black Bluff, Tombigbee river; 1 mi. N. of Midway.

Type.—Paleontological Museum, Cornell Univ.

SCALA.

Scala sp, Pl. 12, fig. 23.

A specimen of this genus was found by the writer in a collection from near Olsen's switch, a few miles southwest of Little Rock, Ark., and was figured in vol. ii, Geol. Surv. Ark., 1892, pl. 3, fig. 2, and is figured herewith. Last summer other, larger, but more imperfect specimens were found ¾ mi. W. of Prairie Bluff, in bed *e*, at the very base of the Midway. They seem to belong to the same species as the Arkansas specimen but are about ½ inch in diameter at base.

SOLARIELLA.

Solariella alabamensis, Pl. 12, fig. 24.

Syn. *Trochus alabamensis* Ald., Bull. No. 1, Geol. Surv. Ala., 1886, p. 35, pl. 5, fig. 16.

Aldrich's original description.—"Shell trochiform, whorls seven, suture deeply impressed, surface marked with four to six strong, revolving lines, with finer ones between, crossed by numerous fine longitudinal striations, which are strongest at the intersecting points; base of the body whorl with finer lines. Umbilicus deep, defined by a sharp carina; aperture rounded; outer lip crenate on its edge, the crenulations running some distance within; inner lip smooth.

"*Locality.*—Matthews' Landing, Ala.

"Generally is smaller than the type; not rare."

Localities.—ALABAMA: Matthews' Landing; 1 mi. W. of Oak Hill.

PLEUROTOMARIA.

"*Pleurotomaria?*" sp., Pl. 12, figs. 25, a.

Syn. *Pleurotomaria?* Ald., Geol. Surv. Ala., 1894, p. 247.

Mr. T. H. Aldrich has kindly sent me these two figures of a specimen which was labelled "Allenton, Wilcox Co., Ala." It belongs to the State Museum at Tuscaloosa. Without seeing the specimen it is unwise to attempt a description of it. From the appearance of the figures, however, it is almost certain that it is from the horizon of beds 18 or 19 of the section on p. 31.

FISSURELLA.

Fissurella mediavia n. sp., Pl. 12, figs. 26, a.

Specific characterization.—General form and size as indicated by the fragment figured; surface marked by about 60? subequal ribs which are crossed by transverse lines making small, raised folds on the top of the ribs.

It has seemed worth while to name, describe and figure this fragment since it is the only member of this genus known from the lower Eocene.

Locality.—ALABAMA: Top of bed 19, 1½ mi. S. W. of Palmer's mill.

Type.—Paleontological Museum, Cornell Univ.

Cephalopoda.

ENCLIMATOCERAS.

Enclimatoceras ulrichi, Pls. 13, 14, 15.

Syn. *Nautilus texanus* White, Proc. U. S. Nat. Mus., vol. iv, 1881, p. 137.
Enclimatoceras (*Nautilus*) *ulrichi* White, Bull. U.S. Geol. Surv., No. 4, 1884, p. 17, pls. 7, 8, 9.
Enclimatoceras hyatti Ald., Bull. Geol. Surv. Ala., No. 1. 1886, p. 60.
Enclimatoceras ulrichi Harris, Ann'l Rep't Geol. Surv. Ark., 1892, p. 36.

This fossil being obviously one of the most characteristic of the Midway stage from Texas to Alabama inclusive, it is deemed advisable to here insert Dr. White's account of it together with his original description as found in Bulletin No. 4 of the U. S. Geological Survey, pages 16 and 17.

"ON THE NAUTILOID GENUS ENCLIMATOCERAS HYATT, AND A DESCRIPTION OF THE TYPE SPECIES.

"In the year 1880 Mr. E. O. Ulrich sent to the Smithsonian Institution a small collection of fossils which he had obtained from the Cretaceous strata near Little Rock, Ark. A part of these fossils were described by me in Vols. III and IV of Proceedings of the United States National Museum; but the Nautiloid shell now described was then only casually noticed. Its peculiarities were recognized at that time, and the specimens were laid aside with the hope that better material might be procured for study. Other specimens belonging to this or a closely related species were afterward collected by Mr. Lawrence C. Johnson from strata supposed to be of Cretaceous age, in Wilcox county, Alabama, but they are no more perfectly preserved than the Arkansas specimens.

"Prof. Alpheus Hyatt having had in hand an exhaustive work on *Nautilus* and its allies, the Arkansas specimens were placed with him for examination. In a preliminary work of his, just published, he divides the genus *Nautilus* as it has been generally recognized, into numerous genera besides those previously proposed by other authors. To one of these groups he has given the generic name *Enclimatoceras*, and made the species here described the type of the genus. The following is his generic diagnosis, which he has also published in the Proceedings of the Boston Society of Natural History, Vol. XXII, 1884, p. 270.

"Genus ENCLIMATOCERAS Hyatt.

"Enclimatoceras includes species of the Trias to the Tertiary, inclusive, which are connected by the outlines of their sutures. The whorls are involute from an early stage, and compressed. The abdomens are rounded, but become acute in many species. The sutures have prominent ventral saddles, flatted in species with rounded abdomens, and acute in those with acute abdomens; never divided by ventral lobes. The lateral lobes are deep, and the lateral saddles well marked. The ventral saddles in the young are broad and closely resemble the ventrals of the *Hercoglossæ*, as do also the broad lateral saddles of the later larval stages in some species. There are no annular lobes at any stage in the Triassic, according to Mojsisovics. They do not seem to be present in some of the Jurassic and Cretaceous species, at least during the early stages, and are very small in some adults. The Triassic species are nearly related to *Grupoceras*, according to Mojsisovics' figures and descriptions in 'Das Gebirge um Hallstatt.' The siphon in this type is a little below the center in the young, though ventral in the adult; and this also agrees with the characteristics of *Enclimatoceras styriacus*, sp. Mojsisovics, of the Trias, and *Grupoceras*. Nevertheless there is no ventral lobe at any stage; the annular lobe is absent in the Triassic forms, and young of later forms; and the siphon in two species is short-funneled, with connective walls, or ellipochoanoidal. Type, *Enclim.* (*Naut.*) *ulrichi* White."

"*Enclimatoceras* (*Nautilus*) *ulrichi* White.

* * * * * *

"Shell moderately large; somewhat narrowly but regularly rounded upon the periphery in the adult state, and broadly rounded at the sides; whorls almost completely involute, the umbilici being very small; septa somewhat deeply concave; ventral saddles large, prominent, and regularly rounded; lateral lobes broad and moderately deep; lateral saddles prominent and narrow, and rounded at the outer end, and also becoming laterally prominent in the later formed septa of adult shells. The character of the surface is unknown, but it is apparently plain; and the test was moderately thin. In the young state the shell was more globose in form, and the septa were much less deeply lobed.

"All the specimens which have yet come under my observation are in the condition of natural casts, and all are imperfect. The best one of these specimens is figured on plates VII, VIII and IX, [represented herewith by Pls. 13, 14, 15] together with a fragment showing the inner volutions. The outlines which

are added to the figures represent the supposed outline of the aperture of the adult shell.

"The diameter of the coil of the type specimen, when perfect, was apparently about 180 millimeters. The greatest transverse diameter about 125 millimeters. Some of the specimens already referred to, which were collected in Alabama by Mr. Johnson, indicate a considerably larger size.

"In Vol. I of the Transactions of the St. Louis Academy of Science Dr. Shumard described a form under the name of *Nautilus texanus*, but which he did not figure. Judging from his description, it seems to agree with the form here described, except for the material difference that it is marked by numerous flexuous transverse ribs, while the surface of our form is evidently plain. The difference between *E. ulrichi* and most of the other Cretaceous Nautiloid shells of the United States has now been made generic by Professor Hyatt, and specific comparisons are therefore unnecessary. The collection sent by Mr. Ulrich to the Smithsonian containing the type specimens of this species, also contains representatives of numerous other species, but all of them, like these types, are imperfect. Among them are *Callianassa ulrichi* White, *Tubulostium dickhauti* White, *Gryphæa pitcheri* Morton?, *Turritella*, *Anchura*, *Axinæa*, *Cucullæa*, etc.

"The type specimens bear the Museum catalogue number 8349; and permission to use them in the preparation of this article has been given by the Director of the Museum."

The surface of this shell is indeed nearly smooth but the substance of the same is quite thick, say at least one-fourth of an inch in many instances. It will be noticed, moreover that Dr. White regards this as a Cretaceous species. This error was first pointed out by L. C. Johnson in his studies of the Pine Barren region of Alabama in 1883. He showed that the Enclimatoceras rock overlies a crystalline limestone holding *Turritella*, *Cardita*, a *Rosellaria* and other forms. (See Bull. 43, U. S. Geol. Surv., 1887, 65-66).

Our figures of this species are from electrotype plates made from the originals used in printing Pls. 7, 8, 9 of Bulletin No. 4 of the U. S. Geological Survey.

This species ranges from the highest to the lowest Midway Eocene bed. (See p. 13).

Localities.—TEXAS: Brazos river, about one mile above the Milam–Falls county line; from ½ to 1 mile up Salt branch from Little Brazos river.

ARKANSAS: Near Olsen's switch, a few miles S. W. of Little Rock (type locality).

TENNESSEE: Hannah's, 1¾ mi. N. of Crainesville.
MISSISSIPPI: ½ mi. N. of Ripley; Blue Mt., near Ripley (pp. 24-25).
ALABAMA: Black Bluff; 4 mi. below Black Bluff, Tombigbee river; almost any of the fields in the vicinity of Prairie Bluff; field 1 mi. N. of Midway; Palmer's mill, from rocks shown in our frontispiece; ½ mi. W. of Graveyard hill; 1 mi. W. of Oak Hill P. O., bed 9; 1 mi. N. of Allenton; Josh Hunter's, Hamburg; 2 mi. N. of Snow Hill; 3½ mi. N. E. of Snow Hill (See Pl. II, opp. p. 32).

Type.—U. S. National Museum collection.

PLATE 1.

EXPLANATION OF PLATE I.

(II)

Page.

Fig. 1. *Ostrea crenulimarginata* Gabb..... 45, **159.**
Exterior, left valve.*
a. Interior, left valve.*
2. *Ostrea pulaskensis* Harris..... 46, **160.**
Exterior, left valve.
a. Posterior view, left valve.
b. Exterior, right valve.
c. Interior, right valve.
3. *Ostrea pulaskensis* Harris. Small variety found immediately above the Cretaceous–Eocene contact line in the vicinity of Prairie Bluff, Ala.
Posterior view, left valve.
a. Exterior, left valve.

NOTE.—All figures are natural size unless otherwise indicated. Those marked (*) in the explanation were drawn by Dr. McConnell of Washington for Mr. Aldrich, and were lent by the latter for use in this publication. Those marked (†) were drawn by McConnell and were published elsewhere as shown by the synonymy. All others were drawn by the author of this Bulletin.

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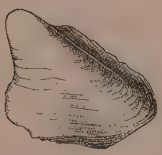

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1a

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3a

PLATE 2.

EXPLANATION OF PLATE 2.

(12)

Page.

Fig. 1. *Ostrea crenulimarginata* Gabb..... 45, **159.**
Exterior, right valve.*
a. Interior, right valve.*
2. *Plicatula?*..... 47, **161.**
Exterior.
a. Interior.
3. *Pecten alabamensis* Aldrich..... 48, **162.**
Interior view, x 3.
4. *Avicula* sp..... 48, **162.**
Cast of left valve.
a. Cast of right valve.

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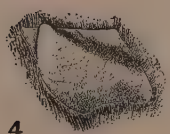

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PLATE 3.

EXPLANATION OF PLATE 3.

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Fig. 1. *Ostrea crenulimarginata* Gabb..... 45, **159.**
(Type specimen).

2. *Perna cornelliana* n. sp..... 48, **162.**

3. *Perna cornelliana* n. sp..... 48, **162.**

4. *Modiola saffordi* Gabb..... 49, **163.**

5. *Modiola saffordi* Gabb; from Texas; young..... 49, **163.**

6. *Modiola subpontis* n. sp..... 49, **163.**
Cast of left valve, x 2.
a. Fragment of exterior imprint, showing markings.

7. *Lithodomus gainesensis* n. sp..... 50, **164.**
Cast of left valve, x 2.
a. Cast of right valve, x 2.

8. *Arca* sp..... 50, **164.**
From a gutta-percha mould, x 2.

9. *Arca*, same species as fig. 8.
From a gutta-percha mould.
a. Cast of interior of fig. 9.

10. *Cucullæa macrodonta* Whitfield..... 51, **165.**
Exterior of left valve.
a. Exterior of right valve.

11. *Cucullæa saffordi* Gabb..... 51, **165.**
(Copy of Gabb's figure).

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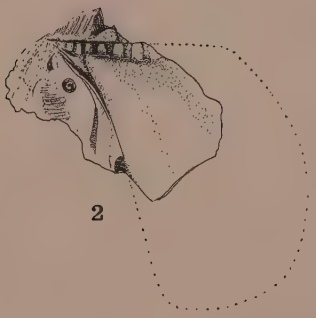
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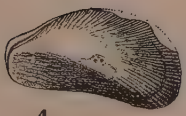
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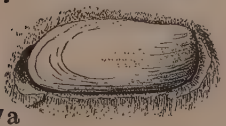
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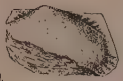
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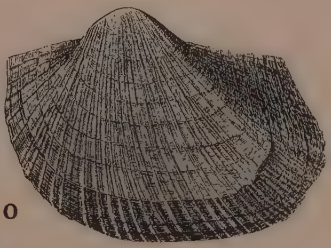
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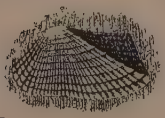
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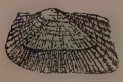
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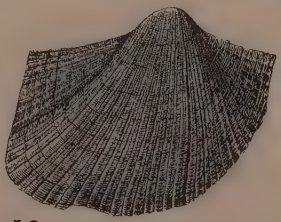
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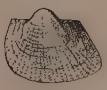
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PLATE 4.

EXPLANATION OF PLATE 4.

(14)

		Page.
Fig. 1.	*Cucullæa saffordi* var	51, **165.**
2.	*Cucullæa saffordi* Gabb	" "
3.	*Pectunculus* sp	53, **167.**
4.	*Nucula mediavia* n. sp	" "
5.	*Nucula ovula* Lea	54, **168.**
6.	*Yoldia kindlei* n. sp	56, **170.**
7.	*Yoldia eborea* Con	" "
8.	*Leda milamensis* Harris	54, **168.**
9.	*Leda saffordana* n. sp	55, **169.**
10.	*Leda elongatoidea* var.? Ald	" "
11.	*Leda quercollis* n. sp	" "
12.	*Venericardia alticostata* Con. var	57, **171.**
13.	*Venericardia planicosta* Lam.*	58, **172.**
14.	*V. planicosta* var. *smithi* Ald.*	59, **173.**

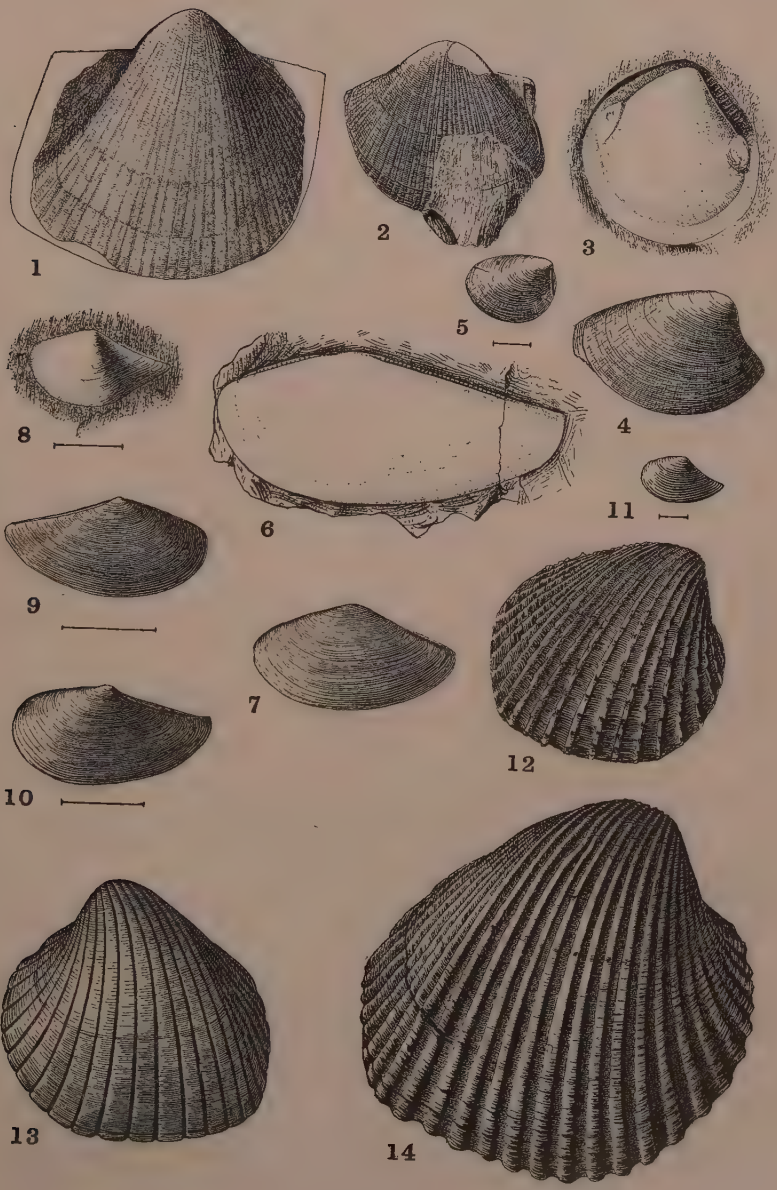
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PLATE 5.

EXPLANATION OF PLATE 5.

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Page.

Fig. 1. *Venericardia planicosta* var. *smithi* Ald..... 59, **173.**
Interior view of fig. 14, pl. 4.*

2. *Venericardia planicosta* var. *smithi* Ald..... " "
Exterior view.*

a. Interior view.*

3. *Venericardia alticostata* Con. var. (from Texas) 57, **171.**

4. *Astarte smithvillensis* var. *mediavia* Harris..... 61, **175.**

5. *Astarte subpontis* n. sp..... 62, **176.**
View from above.

a. Lateral view, cast.

b. Lateral view, gutta-percha mould.

6. *Astarte aldrichiana* n. sp..... " "
Exterior view.

a. Interior view.

7. *Crassatella gabbi* Safford. (Type)..... 63, **177.**
Interior view.

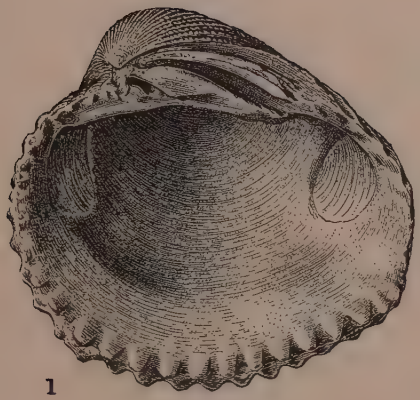
a. Exterior view.

8. *Crassatella gabbi* Safford..... " "
Showing hinge structure.

9. *Crassatella gabbi?* Safford, short form..... " "

10. *Crassatella gabbi* Safford, Brazos river, Texas.. " "

11. *Crassatella gabbi* Safford,† " " " .. " "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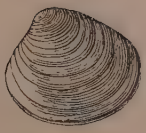
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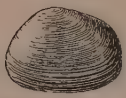
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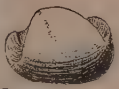
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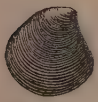
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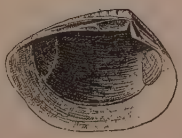
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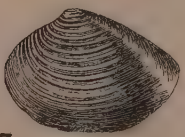
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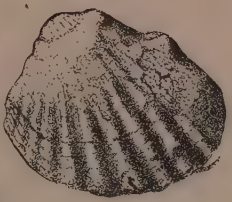
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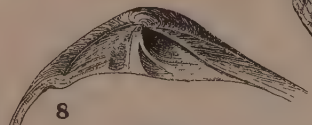
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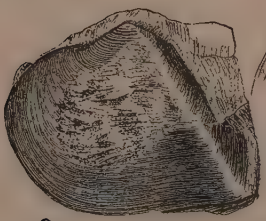
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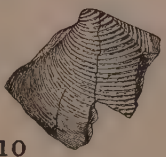
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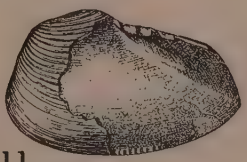
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PLATE 6.

EXPLANATION OF PLATE 6.

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Fig. 1. *Crassatella sepulcollis* n. sp..... 64, **178.**
Exterior view.
a. Interior view.
2. *Protocardia nicolletti* var..... 65, **179.**
3. *Cardium* sp., 18 mi. S. E. of Eagle Pass, Texas.
4. *Chama gainesensis* n. sp..... 66, **180.**
Cast.
a. Gutta-percha mould, showing exterior marking.
5. *Isocardia mediavia* n. sp..... " "
6. *Meretrix ripleyana* Gabb..... 67, **181.**
7. *Meretrix ripleyana?* Gabb..... " "
8. *Tellina* sp..... 68, **182.**
9. *Corbula subcompressa* Gabb..... " "
10. *Lucina claytonia* n. sp..... 69, **183.**
Exterior view, gutta-percha mould.
a. Interior view, gutta-percha mould.
11. *Lucina fortidentalis* n. sp..... " "
Exterior, cast.
a. Interior, cast.
12. *Gastrochæna gainesensis* n. sp., x 2..... 70, **184.**
Cast of left valve.
a. Impression of exterior in its original matrix.
13. *Gastrochæna cimitariopsis* n. sp., x 2..... " "
14. *Gastrochæna* sp., young, (from Ft. Gaines), x 2.
15. *Martesia dalliana* n. sp., x 1⅔..... 71, **185.**
16. *Verticordia* sp..... " "
17. *Pholadomya mauryi* n. sp..... " "
Exterior, right valve.
a. Anterior view.

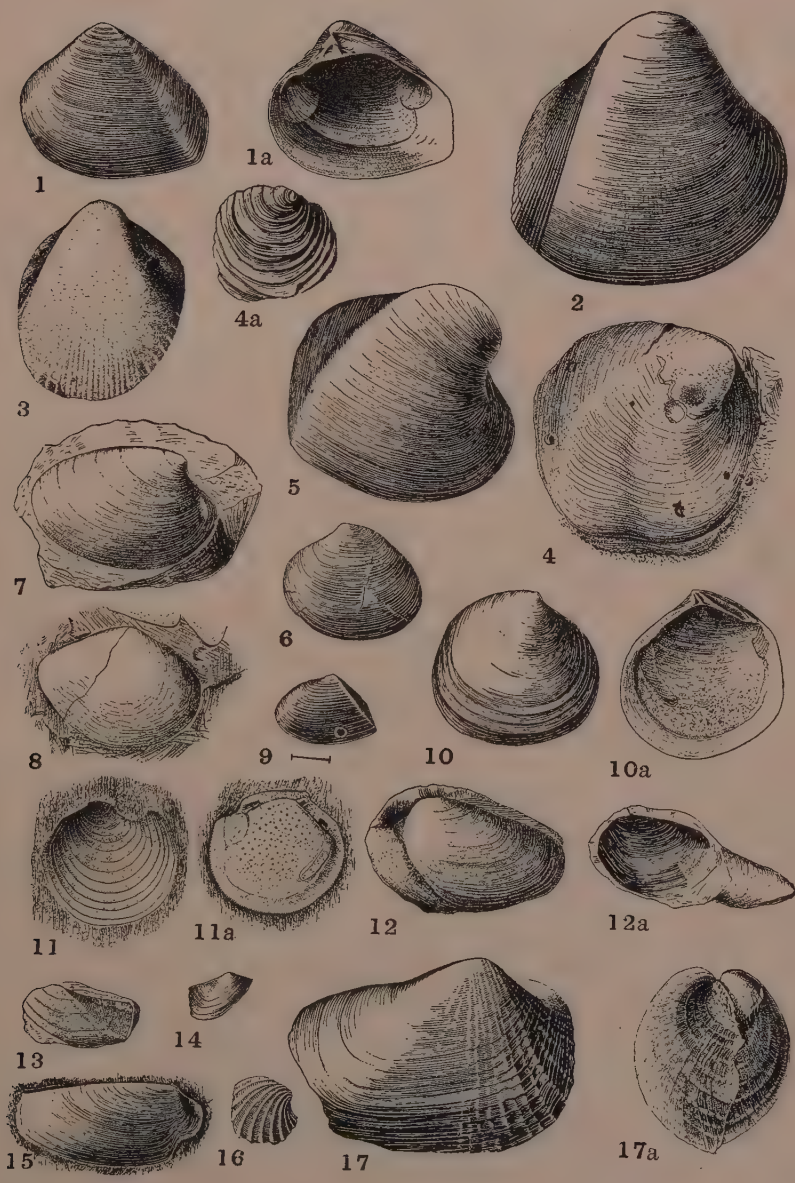
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PLATE 7.

EXPLANATION OF PLATE 7.

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Fig. 1. *Dentalium mediaviense* n. sp..... 73, **187.**
An enlarged fragment; from ½ mi. W. of Graveyard Hill, Ala.
a. The same, internal cast showing general form; from ½ mi. N. of Ripley, Miss.
2. *Cadulus turgidus* Mr., x 3..... " "
3. *Tornatellæa bella* Con..... 74, **188.**
4. *Tornatellæa quercollis* n. sp..... " "
5. *Atys robustoides?* Ald..... " "
6. *Cylichna meyeri* Ald..... 75, **189.**
7. *Cylichna galba?* Gabb. x 3..... " "
8. *Pleurotomella whitfieldi* Ald..... 76, **190.**
9. *Surcula adeona* Whitf., x 2..... " "
10. *Surcula adeona* Whitf..... " "
11. *Surcula persa* Whitf..... 77, **191.**
12. *Surcula anacona* Har.†; slightly enlarged..... " "
13. *Surcula ostrarupis* Harris†..... 78, **192.**
14. *Pleurotoma* sp., x 1½..... " "
15. *Surcula longipersa* n. sp., x 1½..... " "
16. *Pleurotoma mediavia* n. sp., x 2..... 79, **193.**
17. *Pl.* (*Cythara?*) *leania* n. sp..... " "
18. *Pl.* (*Drillia*) *quercollis* n. sp..... " "
19. *Olivella mediavia* n. sp..... 80, **194.**
20. *Caricella leana* Dall..... " "
21. *Scaphella showalteri* Ald..... 81, **195.**
22. *Voluta lyroidea* Ald.*..... 82, **196.**
23. *Scaphella* sp. (from ½ mi. N. of Ripley, Miss.) " "

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PLATE 8.

EXPLANATION OF PLATE 8.

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Fig. 1. *Volutilithes rugatus* Con..... 83, **197.**
2. *V. rugatus* var. *saffordi* Gabb..... " "
3. *Volutilithes limopsis* Con..... 84, **198.**
4. *Volutilithes quercollis* n. sp..... 85, **199.**
5. *Lyria wilcoxiana* Ald..... " "
6. *Voluta florencis* n. sp..... 82, **196.**
Gutta-percha mould.
a. Internal cast.
7. *Mitra subpontis* n. sp..... 86, **200.**
Gutta-percha mould.
a. Internal cast.
8. *Mitra hatchetigbeensis?* Ald..... " "
9. *Fusus quercollis* n. sp..... " "
10. *Fusus hubbardanus* n. sp..... 87, **201.**
11. *Fusus hubbardanus* n. sp..... " "
12. *Fusus meyeri* Ald. var..... " "
13. *Fusus ostrarupis* Har..... 88, **202.**
14. *Fusus* (*Latirus*) *tortilis* Whitf..... 89, **203.**
15. *Fusus mohri* Ald..... " "
16. *Strepsidura? mediavia* n. sp..... 91, **205.**
Back view.
a. Front view.
17. *Strepsidura? mediavia* n. sp..... " "
Showing columellar plaits.

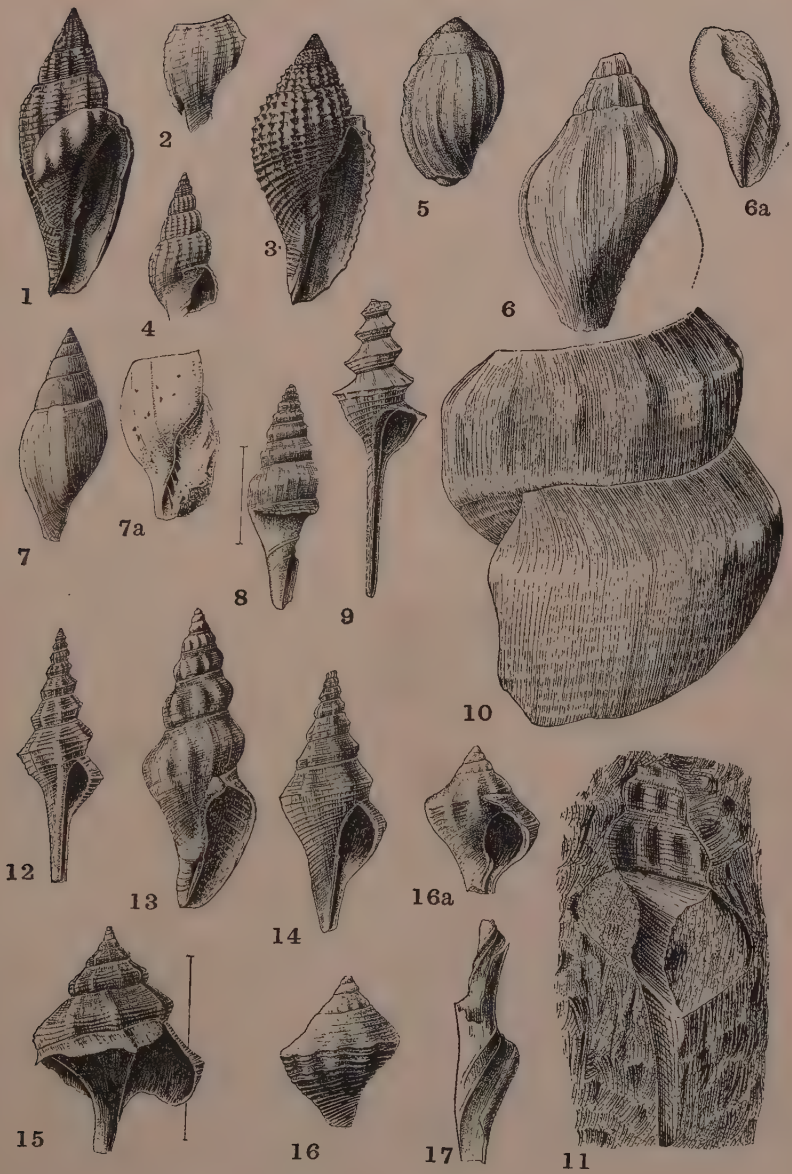
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PLATE 9.

EXPLANATION OF PLATE 9.

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Fig. 1.	*Exilia pergracilis* Con.	90, **204.**
2.	*Pyropsis perula* Ald.	" "
3.	*Strepsidura heilprini* Ald.	91, **205.**
4.	*Leucozonia biplicata* Ald.	92, **206.**
5.	*Mazzalina impressa* Gabb, (crushed specimen)	" "
6.	The same species. Type figured by Gabb.	" "
7.	*Mazzalina impressa* var. *orientalis* n. var.	93, **207.**
8.	*Levifusus pagoda* Heilprin, var.	" "
9.	*Levifusus suteri* Ald.	94, **208.**
10.	*Levifusus trabeatus* Con., var.	95, **209.**
11.	*Levifusus hubbardi* n. sp.; ½ nat. size.	" "
12.	*Levifusus? dalei* n. sp.	96, **210.**
13.	*Fulgur? dallianum* n. sp.	" "
14.	*Neptunea constricta* Ald.	97, **211.**
15.	*Levibuccinum lineatum* Heilprin.	" "
16.	*Pseudoliva unicarinata* Ald.	98, **212.**
17.	*Pseudoliva vetusta* Con., (distorted)	99, **213.**
18.	*Pseudoliva ostrarupis* Har.†; about ¾ nat. size	" "
19.	The same, another view†; about ¾ nat. size.	" "
20.	*P. ostrarupis* var. *pauper* Har.†	" "
21.	*Pseudoliva scalina* Heilprin.	100, **214.**
22.	*Pseudoliva* sp.	" "

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PLATE 10.

EXPLANATION OF PLATE 10.

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Fig. 1. *Trophon morulus* Con., x 2..... 100, **214.**

2. *Murex* (*Pteronotus*) *matthewsensis* Ald., x 2... 101, **215.**

3. *Triton* (*Ranularia*) *eocensis* Ald., x 1½..... " "

4. *Triton* (*Simpulum*) *showalteri* Con., x 1½..... 102, **216.**

5. *Pyrula juvenis* Whitf..... " "

6. *Pyrula juvenis* Whitf., x 1½, showing quadricarinate body whorl and typically crenulated shoulder.

7. *Calyptraphorus velatus* var. *compressus* Ald..... 104, **218.** Back view.* (Enlarged.)

a. Front view.* "

b. Side view.* "

8. Labrum of the same species; showing acute posterior termination. From a cast, 1⅓ mi. N. E. of Clayton.

9. *Aporrhais* sp.,† x 2..... 105, **219.**

10. *Cerithium* (*Companile*) *claytonense* Ald..... " "
Showing internal plaits.*

11. The same species; exterior view.*

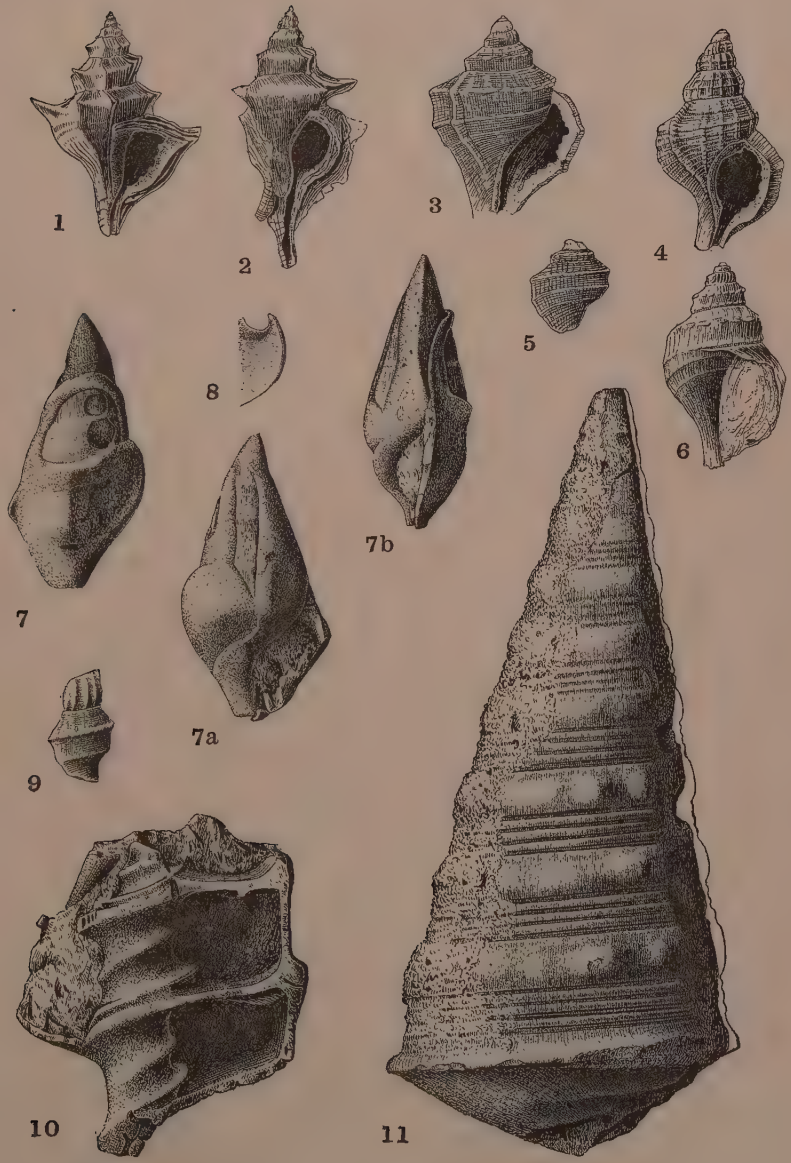
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PLATE II.

EXPLANATION OF PLATE 11.

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Fig. 1.	*Cerithium gainesense* n. sp.	106, **220.**
2.	*Cerithium globoleve* n. sp.	" "
3.	*Cerithium mediaviæ* n. sp.	107, **221.**
	Gutta-percha mould.	
	a. Aperture of this species.	
4.	*Cerithium penrosei* Harris.†	" "
5.	*Turritella tennesseensis* Gabb.	108, **222.**
6.	*Turritella alabamiensis* Whitf.*	109, **223.**
7.	*Turritella saffordi* Gabb.	" "
8.	*Turritella mortoni* var.	110, **224.**
9.	*T. mortoni* var. *levicunea* n. var.	" "
10.	*Turritella* var. of *humerosa?* *	" "
11.	*Turritella humerosa* Con.*	" "
12.	*Turritella humerosa* Con. var.	" "
13.	*Turritella humerosa* Con. var.†	" "
14.	*Turritella nerinexa* Har.†	111, **225.**
15.	*Mesalia pumila* Gabb, (Type specimen)	112, **226.**
16.	*M. pumila* var. *wilcoxiana* Ald.†; from Texas	" "
17.	*M. pumila* var. *wilcoxiana* Ald.* (Type)	" "
18.	*M. pumila* Gabb, var.	" "
19.	*M. pumila* var. *hardemanensis* Gabb.	" "
20.	*M. pumila* var. *allentonensis* Ald.*	113, **227.**
21.	*M. pumila* var. *allentonensis* Ald.*	" "

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PLATE 12.

EXPLANATION OF PLATE 12.

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Fig. 1. *Mesalia alabamiensis* Whitf., x 2..... 113, **227.**
2. *Mesalia watsonensis* n. sp..... 114, **228.**
3. *Mesalia?*, x 2..... " "
4. *Solarium alabamense* Dall; 5.3 mm..... " "
5. *Solarium periscelidium* Dall; 9.0 mm..... 115, **229.**
6. *Solarium* sp..... " "
7. *Rissoina alabamensis* Ald..... " "
8. *Keilostoma mediavia* n. sp..... 116, **230.**
9. *Keilostoma mediavia* n. sp..... " "
Lateral view, showing aperture.
a. Front view.
10. *Calyptræa* sp..... " "
11. *Calyptræa* sp..... " "
12. *Xenophora* sp..... 117, **231.**
13. *Xenophora* sp..... " "
14. *Natica* (*Girodes*) *alabamiensis* Whitf..... " "
15. *Natica mediavia* n. sp..... " "
16. *Natica limula* Con..... 118, **232.**
17. *Natica onusta* Whitf..... " "
18. *Natica saffordia* n. sp..... " "
19. *Natica reversa* Whitf..... 119, **233.**
20. *Natica eminula* Con..... " "
21. *Natica perspecta* Whitf..... " "
22. *Amaura* (*Amauropsis?*) *tombigbeensis* n. sp... 120, **234.**
23. *Scala* sp..... " "
24. *Solariella alabamensis* Ald..... " "
25. *Pleurotomaria?*..... 121, **235.**
Viewed from below.*
a. Lateral view.*
26. *Fissurella mediavia* n. sp..... " "
Lateral view.
a. Viewed from above.

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PLATE 13.

EXPLANATION OF PLATE 13.

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Enclimatoceras ulrichi White..... 122, **236.**

Lateral view of adult, and two views of a young specimen. (Types).

NOTE.—This and the two following plates are from Bull. 4, U. S. Geological Survey.

PLATE 14.

EXPLANATION OF PLATE 14.

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Enclimatoceras ulrichi White..... 122, 236.

Front view.

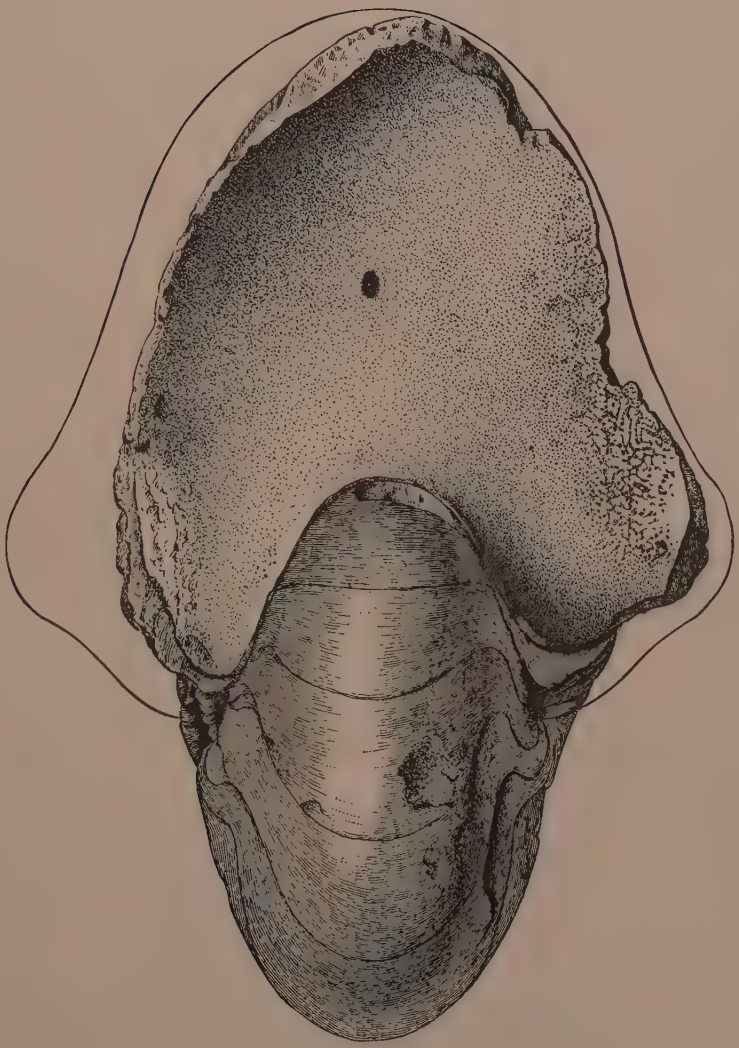

PLATE 15.

EXPLANATION OF PLATE 15.

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Enclimatoceras ulrichi White..... 122, 236.

Back view.